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A design for a General City Hospital

Architecture

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A DESIGN FOR A GENERAL CITY HOSPITAL

BY

WARREN WILLIAM DAY

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THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN

ARCHITECTURE

---

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

1910 *m*



UNIVERSITY OF ILLINOIS

June 2, 1900

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

WARREN WILLIAM DAY.

ENTITLED A DESIGN FOR A GENERAL CITY HOSPITAL.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF BACHELOR OF SCIENCE IN

ARCHITECTURE.

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Architecture.

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Schedule of Rooms and Their Approximate Sizes  
in This Thesis Design.

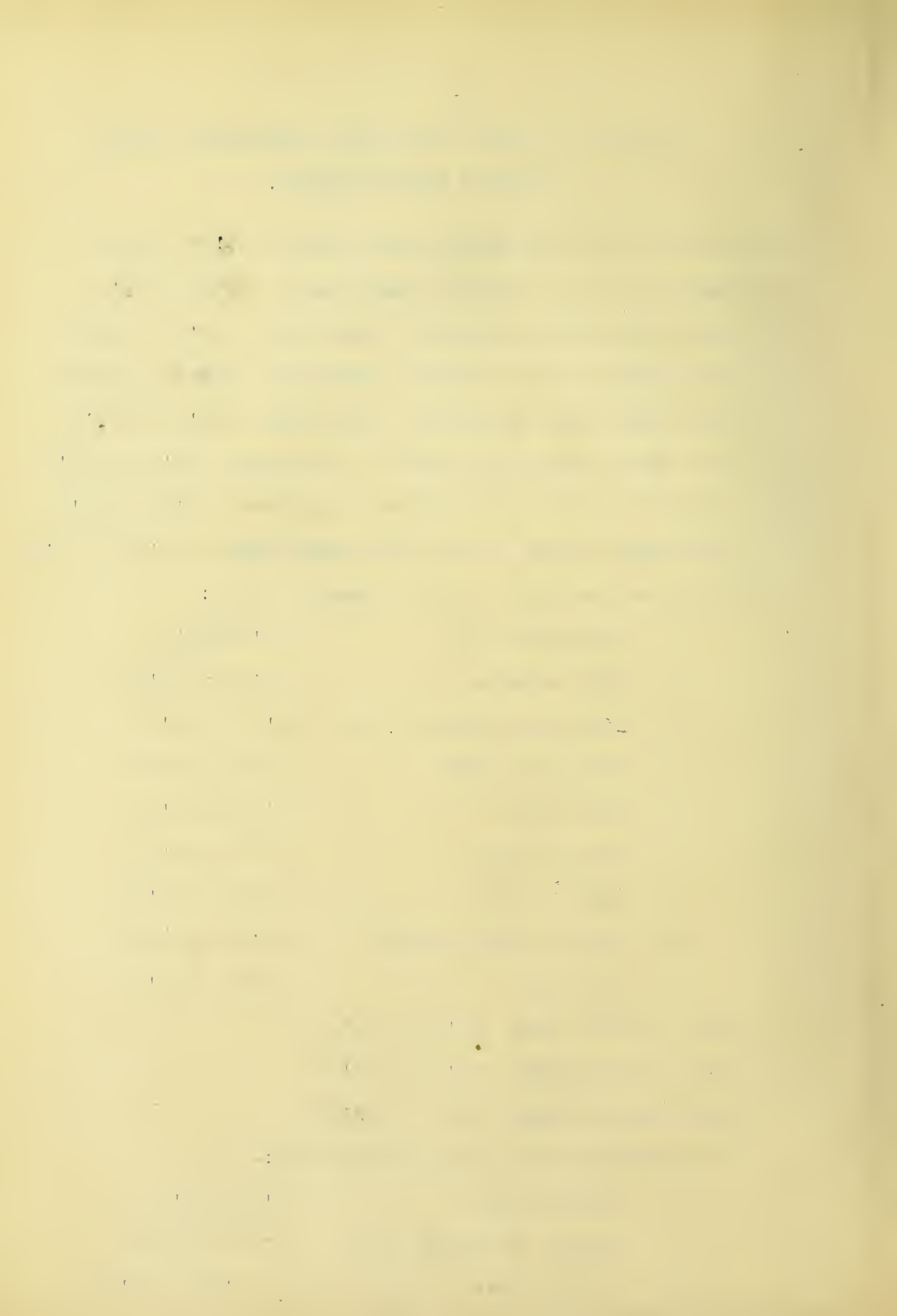
- 1 - 6 bed male ward in Medical Department 23'0" x 30'0"
- 1 - 8 bed male ward in Medical Department 30'0" x 31'0"
- 2 - 6 bed male wards in Surgical Department 23'0" x 30'0"
- 1 - 6 bed female ward in Medical Department 23'0" x 30'0"
- 1 - 8 bed female ward in Medical Department 30'0" x 31'0"
- 2 - 6 bed female wards in Surgical Department 23'0" x 30'0"
- 2 - 6 bed male wards in Childrens Department 23'0" x 30'0"
- 2 - 6 bed female wards in Childrens Department 23'0" x 30'0"

In connection with each two general wards:-

- 1 - dressing room 10'0"x15'0"
  - 1 - diet kitchen 10'0" x 15'0"
  - 1 - linen and locker room 10'0" x 12'0"
  - 1 - medicine closet 8'0" x 10'0"
  - 1 - bath room 8'0" x 12'0"
  - 1 - toilet room 8'0" x 12'0"
  - 1 - nurse's room 10'0" x 15'0"
  - 1 - soiled linen closet 8'0" x 10'0"
  - 1 - Solarium 10'0" x 30'0"
- 
- 5 - 1 bed private wards 12'0" x 15'0"
  - 6 - 1 bed private wards 10'0" x 15'0"
  - 6 - 1 bed private wards 10'0" x 14'6"

In connection with the private wards:-

- 1 - service room 8'0"x 15'0"
- 1 - locker and linen room 8'0" x 15'0"
- 14 - private bath & toilet rooms 8'0" x 10'0"



- 1 - 4 bed maternity ward 15'0" x 28'0"
- 1 - delivery room 10'6" x 15'0"
- 1 - baby room 11'0" x 15'0"
- 1 - 1 bed private maternity ward 12'0" x 15'0"
- 1 - 1 bed private maternity ward 10'6" x 12'0"

In connection with the maternity department:-

- 1 - toilet room 8'0" x 15'0"
- 1 - bath room 11'0" x 15'0"
- 1 - Operating Room 20'0" x 31'0"

In connection with the operating room:-

- 1 - sterilizing room 10'0" x 12'0"
- 1 - anaesthetic room 10'0" x 12'0"
- 1 - recovery room 10'0" x 12'0"
- 1 - nurses room 10'0" x 12'0"
- 1 - surgeons room 10'0" x 12'0"
- 1 - X-ray room 10'0" x 12'0"
- 1 - Waiting room 10'0" x 12'0"
- 1 - bandage and instrument room 10'0" x 12'0"
- 1-2 bed recovery ward 12'0" x 20'6"
- 1 - bath room 10'0" x 12'0"
- 1 - toilet room 10'0" x 12'0"
- 15 - double bed nurses rooms 12'0" x 12'0"

In connection with each ten to fifteen rooms:-

- 1 - bath and toilet room 8'0" x 10'0"
- 1 - head nurses' suite

Comprising:-

- 1 - bed room 10'0" x 12'0"
- 1 - sitting room 10'0" x 12'0"



- 1 - toilet and bath room 7'6" x 8'0"
- 1 - nurses' parlor 15'0" x 25'0"
- 1 - superintendents' suite

Comprising:-

- 1 - bed room 10'0" x 12'0"
- 1 - sitting room 10'0" x 12'0"
- 1 - toilet and bath room 8'0" x 10'0"
- 1 - house physicians' suite

Comprising:-

- 1 - bed room 10'0" x 12'0"
- 1 - sitting room 10'0" x 12'0"
- 1 - toilet and bath room 8'0" x 10'0"
- 2 - bed rooms for internes 12'0" x 15'0"

In connection:-

- 1 - bath and toilet room 8'0" x 10'0"
- 20 - single bed rooms for domestics 10'0" x 12'0"

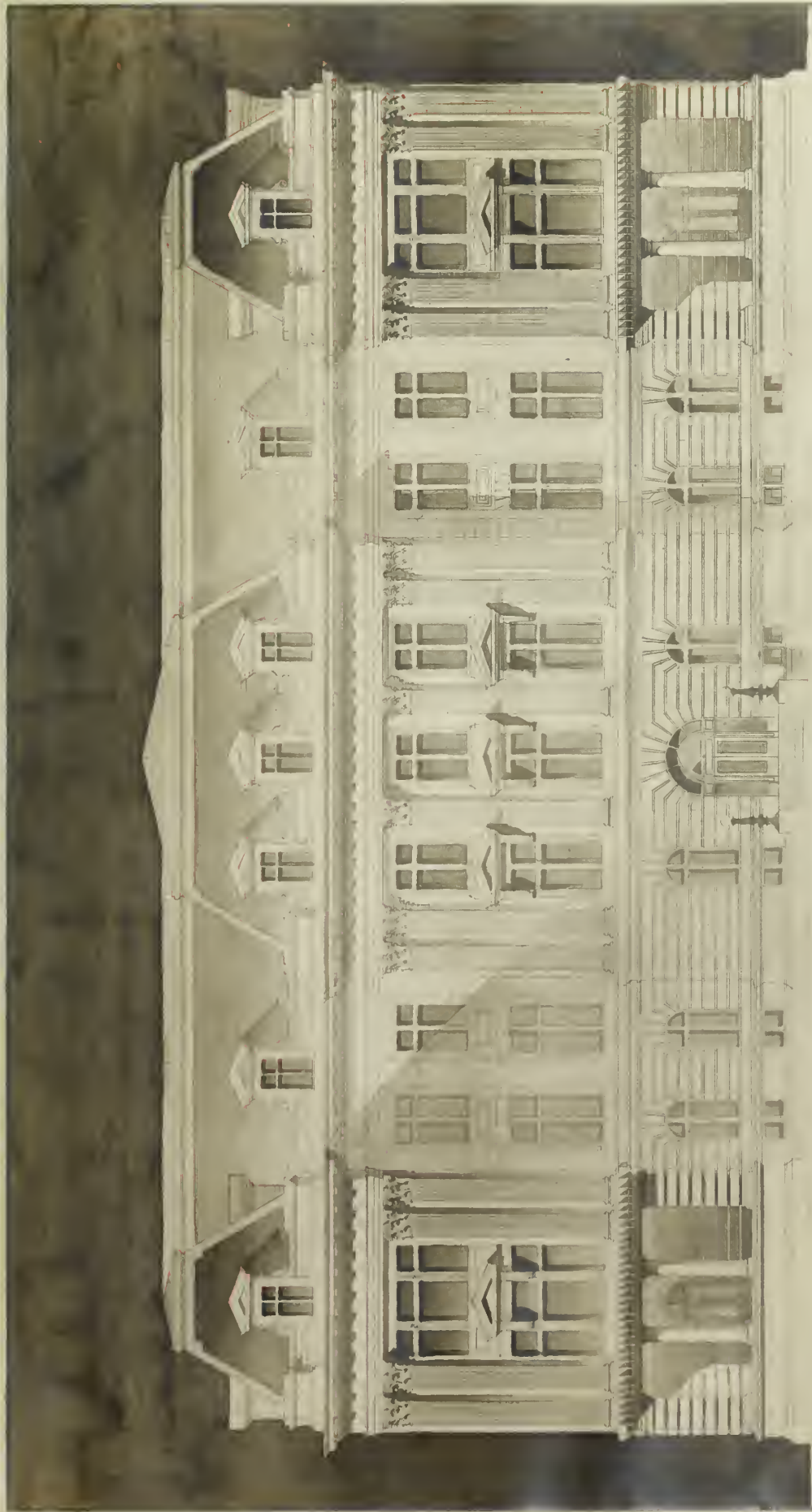
In connection with each ten rooms:-

- 1 - bath and toilet room 8'0" x 10'0"
- 1 - receiving room 18'0" x 20'0"
- 1 - general office 18'0" x 20'0" with a vault 8'0" x 10'0"
- 1 - storage vault in basement 8'0" x 10'0"
- 1 - superintendents' office 13'0" x 15'0"
- 1 - dispensary 15'0" x 20'0"
- 1 - out patients waiting room 12'0" x 15'0"
- 1 - out patients examining room 10'0" x 12'0"
- 1 - library 15'0" x 20'0"
- 1 - gymnasium 17'0" x 60'0"



1 - museum	15'0" x 25'0"	comprising { Preparation Room 12'0" x 14'6" Cold Storage Rm. 12'0" x 15'6" Identification Rm. 12'0" x 15'6"
1 - morgue		
1 - autopsy room	15'0" x 20'0"	
1 - general kitchen	20'0" x 30'0"	
1 - special diet kitchen	10'0" x 12'0"	
1 - kitchen pantry	10'0" x 12'0"	
1 - butler's pantry	10'0" x 12'0"	
1 - scullery	10'0" x 12'0"	
1 - serving room	15'0" x 20'0"	
1 - domestics dining room	15'0" x 20'0"	
1 - staff dining room	20'0" x 30'0"	
1 - bakery	18'0" x 20'0"	
1 - cold storage room	15'0" x 20'0"	
1 - store room	15'0" x 20'0"	
1 - laundry	20'0" x 30'0"	
1 - drying room	18'0" x 20'0"	
1 - ironing room	12'0" x 15'0"	
1 - sewing room	12'0" x 15'0"	
1 - linen store room	15'0" x 20'0"	
1 - janitors room	12'0" x 15'0"	
1 - coal room	15'0" x 20'0"	
1 - boiler room	20'0" x 30'0"	
1 - laboratory	20'0" x 30'0"	
1 - air chamber	20'0" x 30'0"	
Corridors 10' wide		
Elevator Shaft	8'6" x 12'0"	
Stair Shaft	12'6" x 22'0"	





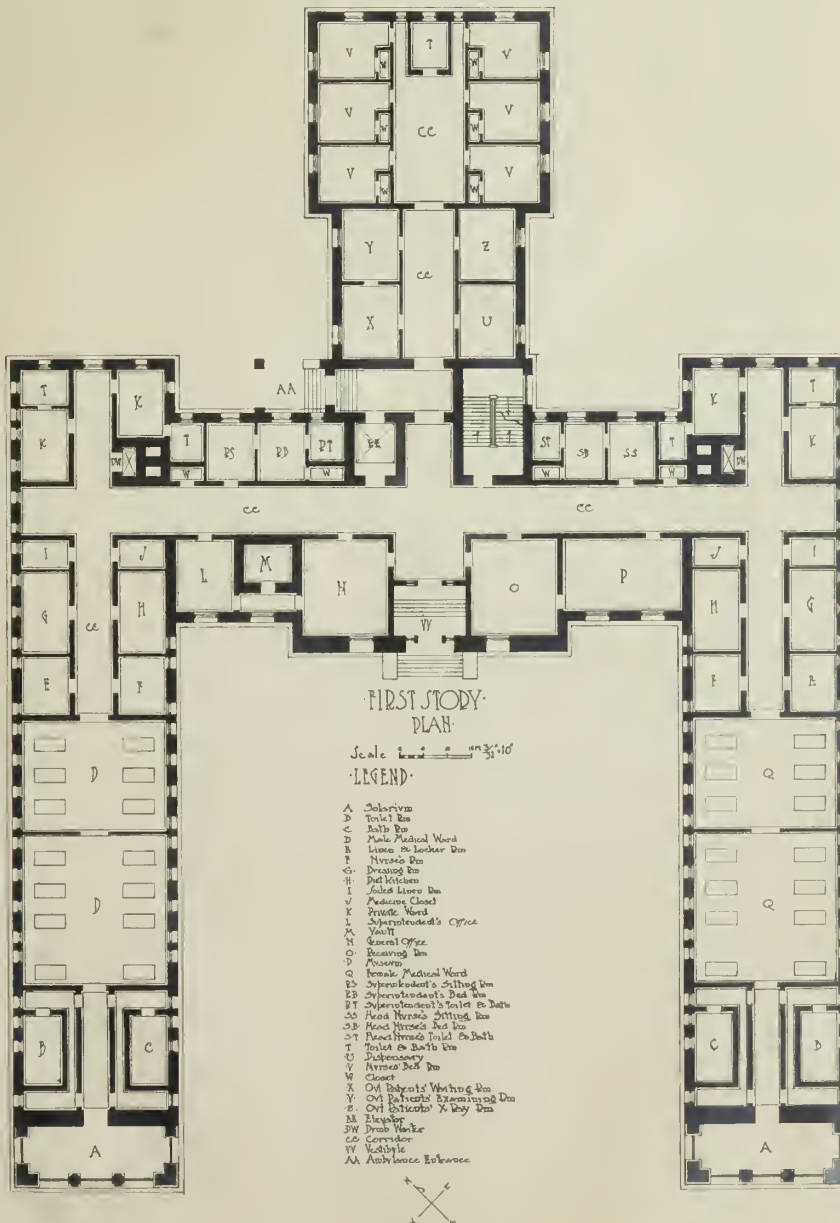
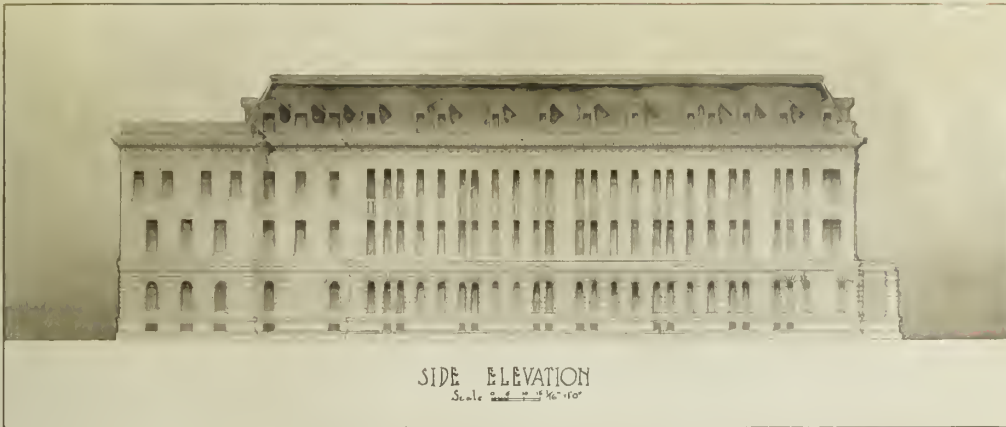
*Irish Garden*

DESIGN FOR A GENERAL CITY HOSPITAL

Scale 1/16" = 1'-0"

*Oct. 1890*

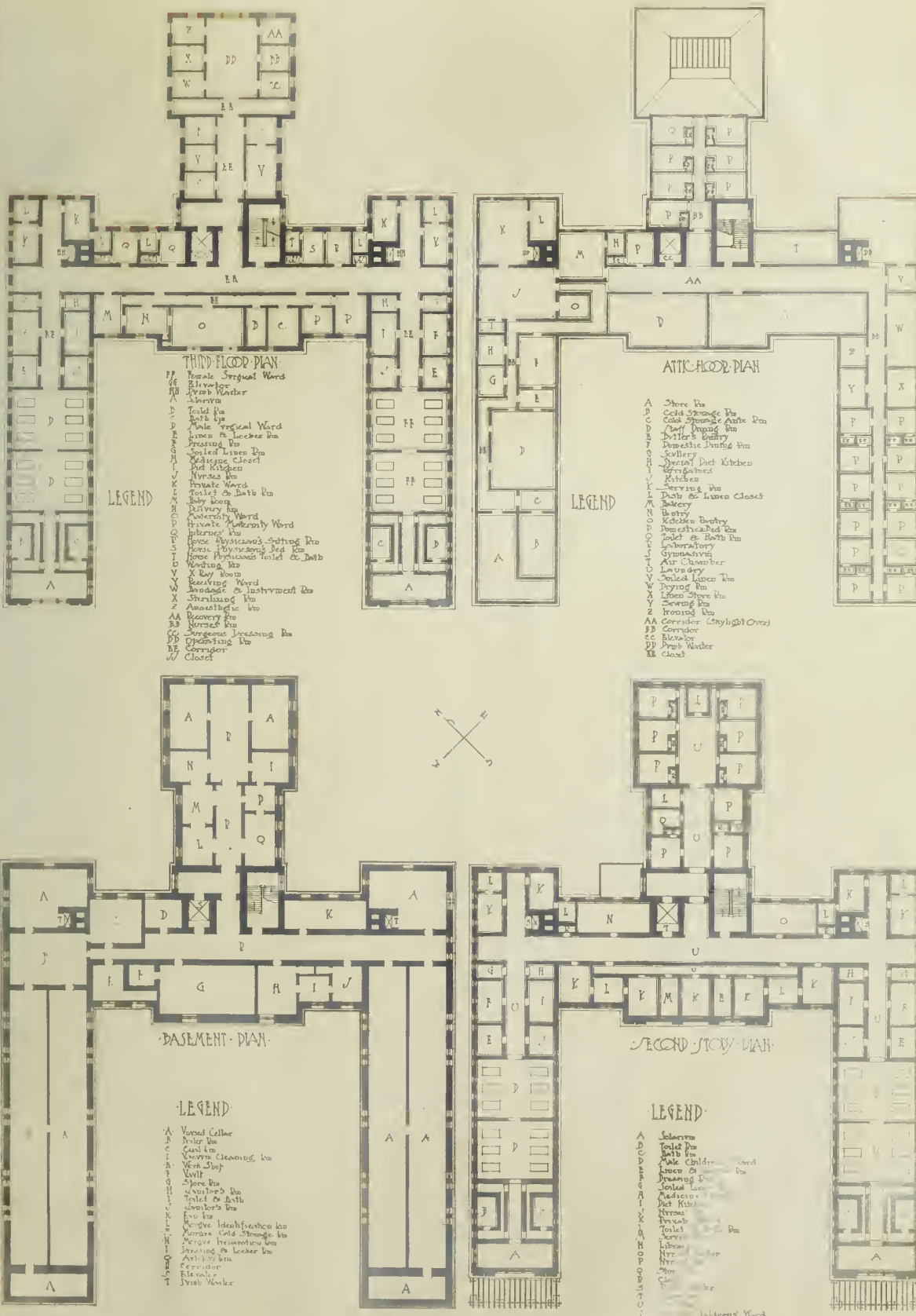




DESIGN FOR A GENERAL CITY HOSPITAL

*Handwritten signature and date:* H. H. May 1910





# DESIGN FOR A GENERAL CITY HOSPITAL

1954

F. H. Davis  
90



THE GENERAL CITY HOSPITAL.

NAME OF ROOM.	BELLEVUE.	ST. LUKE'S.	MT. SINAI.	DELGADO MEMORIAL.	NEW WATERBURY.
GENERAL WARD.	30.0" x 88.0"	30.0" x 75.0"	38.0" x 83.0"	22.0" x 23.0"	29.0" x 47.6"
PRIVATE WARD.		13.0" x 16.0"	11.0" x 16.6"	14.8" x 17.0"	9.6" x 16.0"
TOILET ROOM.	8.0" x 15.0"	8.0" x 11.0"	8.0" x 10.0"	12.0" x 14.0"	8.0" x 9.6"
BATH ROOM.	8.0" x 12.0"	12.0" x 15.0"	8.6" x 10.0"	5.6" x 14.0"	8.0" x 10.6"
DIET KITCHEN.	11.6" x 13.0"	8.0" x 16.0"	12.0" x 19.0"	10.0" x 14.0"	14.0" x 20.0"
LINEN ROOM.	} 8.0" x 14.0"		6.0" x 8.6"		9.0" x 10.0"
LOCKER ROOM.		4.0" x 14.0"			
DRESSING ROOM.	17.0" x 21.0"			11.6" x 14.0"	
MEDICINE ROOM.	2.0" x 3.0"	10.0" x 13.0"			
NURSES' ROOM.		13.0" x 15.0"	10.0" x 19.0"		
SOLARIUM.	8.0" x 22.0"				
OPERATING ROOM.	25.0" x 30.0"		26.0" x 36.0"	16.0" x 22.0"	22.0" x 28.6"
ANAESTHETIC ROOM.	8.0" x 12.0"		9.0" x 18.6"	12.0" x 14.0"	10.0" x 12.0"
STERILIZING ROOM.	11.0" x 21.0"		8.0" x 15.0"	10.0" x 14.0"	7.0" x 10.0"
RECOVERY ROOM.	10.0" x 12.0"		7.6" x 18.6"	11.0" x 14.0"	9.6" x 10.0"
NURSES' ROOM.	10.0" x 12.0"			8.0" x 9.0"	
SURGEONS' ROOM.	10.6" x 13.0"			8.0" x 13.0"	6.0" x 10.0"



TABULATION OF ROOMS IN NOTEWORTHY EXAMPLES OF  
THE GENERAL CITY HOSPITAL.

NAME OF ROOM.	BELLEVUE.	ST. LOUKES.	MT. SINAI.	DELGADO MEMORIAL.	NEW WATERBURY.
BANDAGE ROOM.	12'0" x 15'0"			9'0" x 14'0"	} 10'0" x 13'0"
INSTRUMENT ROOM.	8'0" x 12'0"		8'0" x 16'6"	6'0" x 14'0"	
X RAY ROOM.			10'0" x 24'0"		
WAITING ROOM.					
RECEIVING ROOM.	70'0" x 100'0"		17'0" x 24'0"		9'6" x 16'0"
GENERAL OFFICE.					9'6" x 16'0"
SUPERINTENDENT'S OFFICE.	20'0" x 30'0"				
" " BED ROOM.					9'6" x 10'0"
" " SITTING ROOM.					9'6" x 16'0"
" " BATH AND TOILET.					5'6" x 9'6"
HEAD NURSES' BED ROOM.					
" " SITTING ROOM.					
" " BATH AND TOILET.					
NURSES' BED ROOM.		8'0" x 17'0"			
SERVANTS' BED ROOM.		8'0" x 17'0"	7'6" x 21'0"		
NURSES' PARLOR.					
MATERNITY WARD.	30'0" x 65'0"				



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TABULATION OF ROOMS IN NOTEWORTHY EXAMPLES OF  
THE GENERAL CITY HOSPITAL.

NAME OF ROOM.	BELLEVUE.	ST. LOUIS.	MT. SINAI.	DELGADO MEMORIAL.	NEW WATERBURY.
PRIVATE MATERNITY WARD.	10.0' x 12.0"				
DELIVERY ROOM.	20.0' x 20.0"				
BABY ROOM.	12.0' x 26.0"				
DISPENSARY.	24.0' x 56.0"				
OUTPATIENTS RECEIVING ROOM.	56.0' x 64.0"				
OUTPATIENTS EXAMINING ROOM.	60.0' x 150.0"			12.0' x 4.0"	
LABORATORY.	30.0' x 34.0"	38.0' x 38.0"			
LIBRARY.	1500 SQ. FT.				
MUSEUM.					
GYMNASIUM.					
ROOMS FOR INTERNES.	9.0' x 14.0"				
KITCHEN.	96.0' x 140.0"		28.0' x 38.0"		
FERVING ROOM.				11.6' x 14.0"	
SCULLERY.					
BUTLER'S PANTRY.					
BAKERY.	50.0' x 64.0"				
DOMESTICS DINING ROOM.	60.0' x 100.0"				

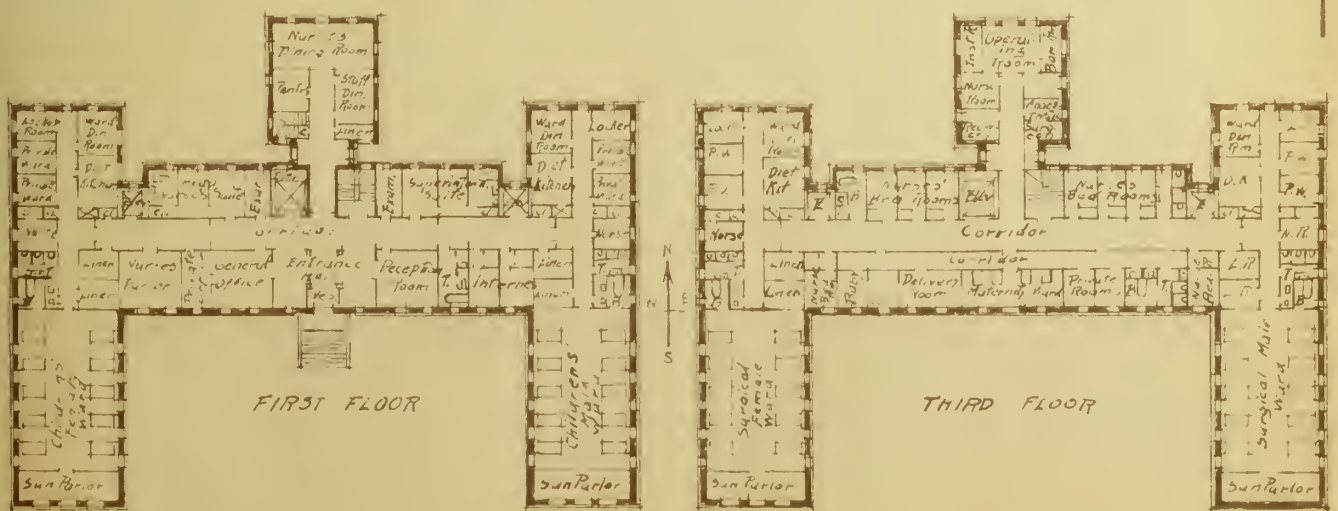
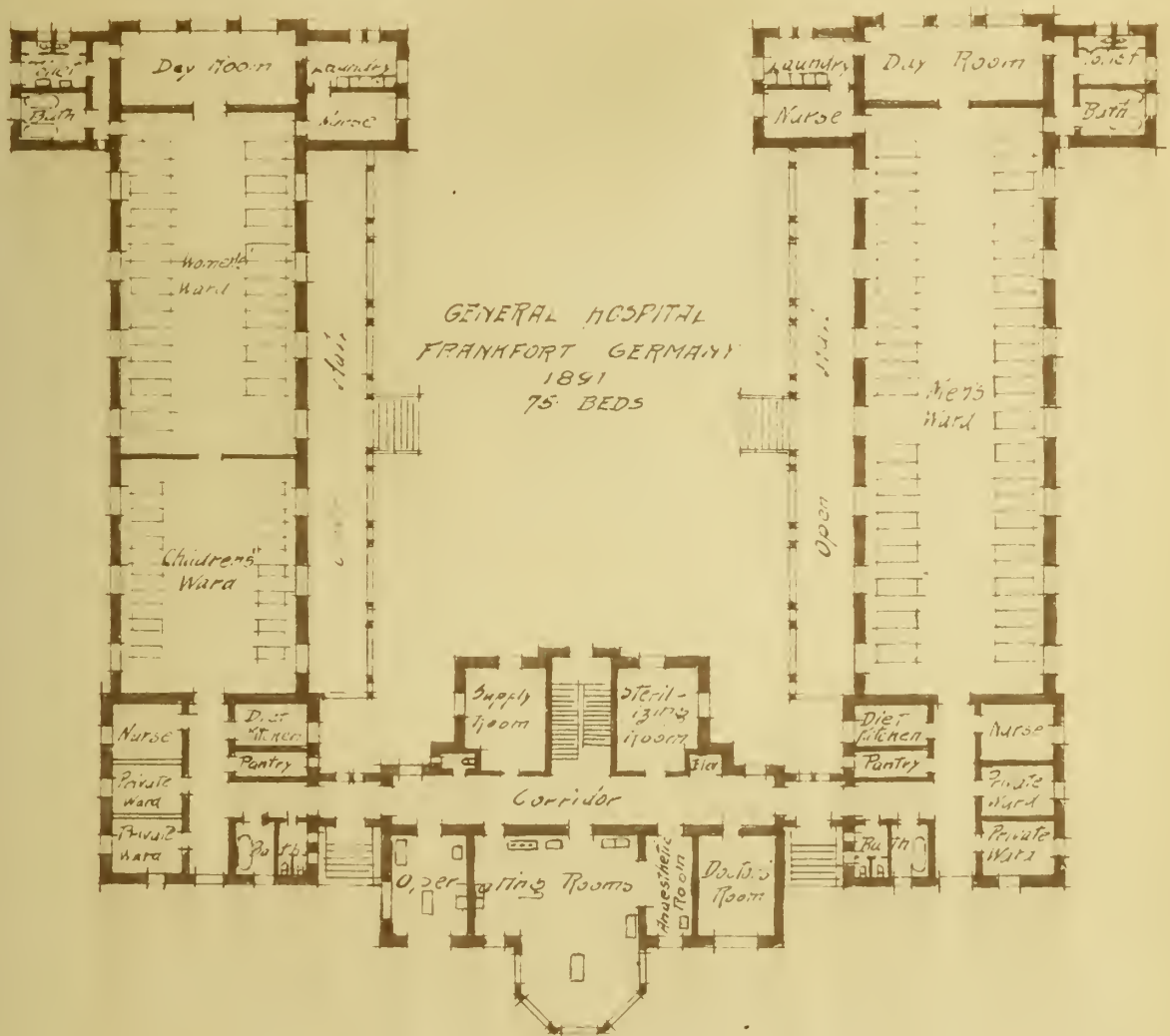


# TABULATION OF ROOMS IN NOTEWORTHY EXAMPLES OF.

## THE GENERAL CITY HOSPITAL.

NAME OF ROOM.	BELLEVUE	ST. LUKE'S.	MT. SINAI.	DELGADO MEMORIAL.	NEW WATERBURY.
STAFF DINING ROOM.	30'0" x 80'0"				
LAUNDRY.					
IRONING ROOM.	76'0" x 230'0"				
DRYING ROOM.					
SEWING ROOM.					
SOILED LINEN ROOM.					
LINEN STORE ROOM.	3200 SQ. FT.				
STORE ROOM.					
COLD STORAGE ROOM.	10005 SQ. FT.		10'0" x 29'0"		
JANITOR'S ROOM.					
COAL ROOM.					
BOILER ROOM.	80'0" x 96'0"				
AIR CHAMBER.					
CORRIDORS.		9'0"	9'0"	10'0"	7'6"
HEIGHT OF STORIES.	12'6" TO 20'0"	17'0"			
MORQUE.	24005 SQ. FT.				
AUTOPSY ROOM.	28'0" x 78'0"				



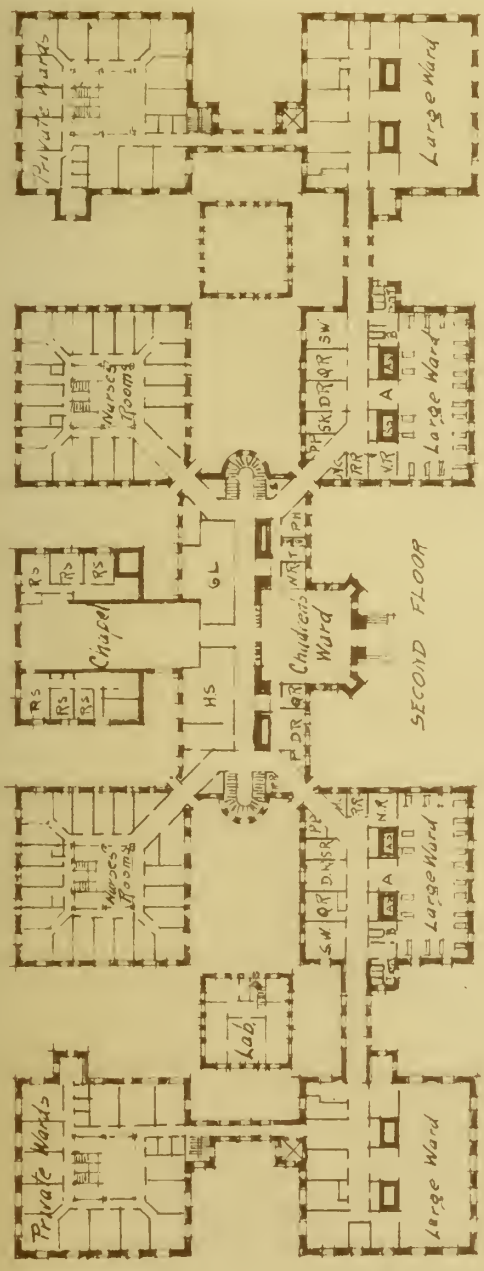


FIRST PRIZE

BRICKBUILDER - HOSPITAL - COMPETITION 1909

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12-36  
OF THE  
UNIVERSITY of ILLINOIS

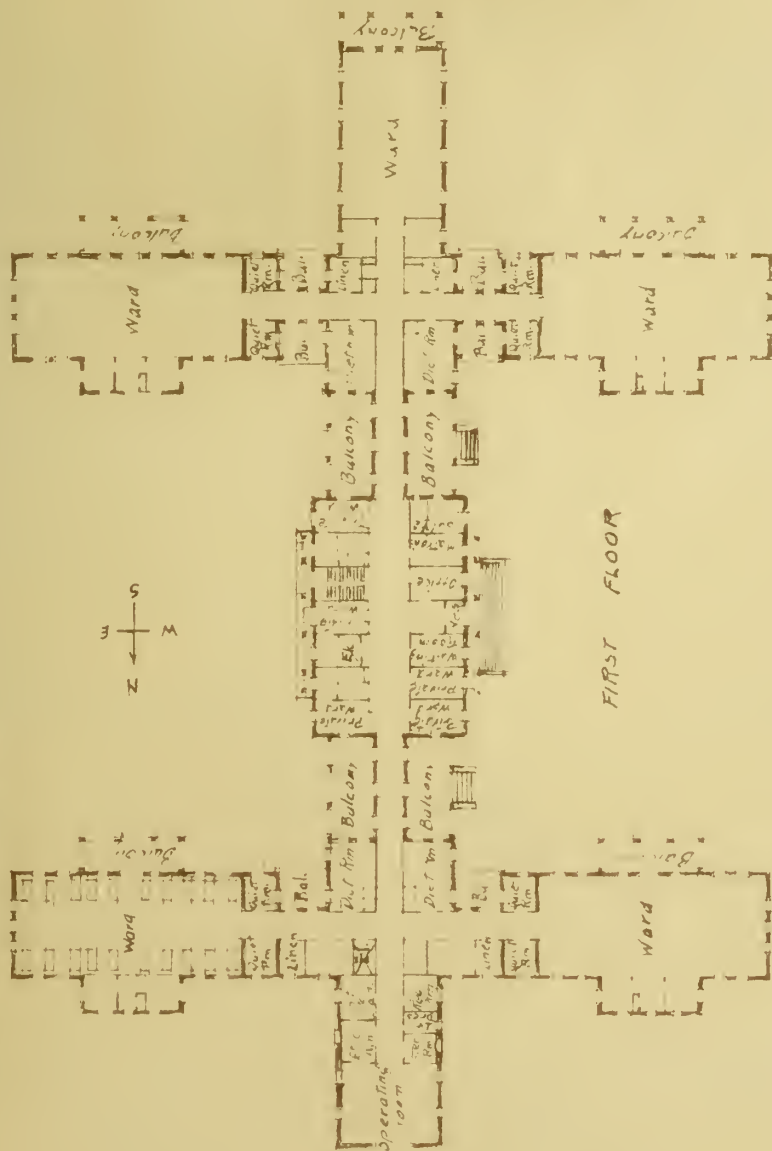


ST. LUKE'S HOSPITAL - NEW-YORK-CITY



MT. SINAI - HOSPITAL - NEW-YORK-CITY





NEW-WATERBURY-HOSPITAL - WATERBURY-CONN.

UNIVERSITY OF THE  
WEST OF ENGLAND  
BIRMINGHAM

Noteworthy Examples of the General City Hospital.

United States.

Mt. Sinai	New York City.
St. Lukes	" "
Bellevue	" "
Presbyterian	" "
Brigham	Boston, Mass.
New Waterbury	Waterbury, Conn.
Augustana	Chicago.
St. Marys	"
St. Josephs	"
Marine	"
Delgado Memorial	New Orleans, La.

Germany.

General	Frankfurt.
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Turkey.

British	Constantinople.
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and Construction.



## The General City Hospital .

The word hospital has its derivation in the Latin hospitalis (adjective) and from the noun hospes, a host or guest. In time the adjective became used as a noun and the words hospitalis, hospitale, now **hopital** and hospitalia, were adopted. The English word hospital comes from the old French hospitale. The word hospital usually means an establishment for temporary occupation by the sick and injured. The definition of the word hospital according to Websters Dictionary is, "a building in which the sick or infirm are treated; a public or private institution founded for the reception and cure, or for the refuge, of persons diseased in body or mind, or disabled, and in which they are treated either at their own expense, or more often by charity in whole or in part."

Hospitals are simply the development of the dispensary used in ancient times by medical officers appointed and paid by the state. These dispensaries existed before the time of Christ.

In this country great attention is paid to the subject of hospitals and hospital building. The increasing interest, and the increasing demand, has influenced thoughtful, skillful men to make the study of hospital construction a life work, and in consequence the present century must undoubtedly mark a new era in all matters pertaining to the organization, construction, and management of hospitals. The influence of dampness, dust and absence of sunlight has become an important factor to be studied in connection with these buildings.

Hospital construction has now reached such a state of perfection that with all possible modern facilities as regards



location, heating, ventilating, lighting and plumbing, the sick can be placed under hygienic conditions which correspond to those to be desired by persons in health.

Hospitals are classified as General and Special. General hospitals are those in which cases of all kinds, except contagious or infectious, are admitted. Under the head Special Hospitals are classified:-

Hospitals for the insane.

- " " " neurasthenics.
- " " " contagious diseases.
- " " " tuberculosis.
- " " " epidemics.
- " " " obstetrical patients.
- " " " surgical patients.
- " " " children's diseases.
- " " " diseases of the eye, ear and throat.

Military Hospitals.

Naval Hospitals.

This paper deals with the General Hospital located in a city, but most of the data contained herein applies to any hospital.

Large sized hospitals are those having 100 beds or more.

Medium sized hospitals are those with 25 to 100 beds.

Those best qualified to judge seem to be of the opinion that every civilized community requires one hospital bed for each one hundred inhabitants.

Until very recently the construction of hospitals was almost a matter of accident, no one having given the subject any



special attention.

It is of enormous importance to every community that a hospital supply the greatest amount of hospital care of the best quality to the greatest number of patients at the smallest possible expense as regards, (a), the construction of the hospital; (b), the maintenance of the hospital; (c), the expansion of the hospital, as the demand for hospital beds increases in the community.

It is quite as important to build a hospital with a view to economy in its maintenance after it has been constructed, as it is to secure economy in the construction itself; because there is a wide difference between the expense of conducting an institution which is conveniently planned and one which is planned without regard to the convenience of its management.

The average cost of maintaining a bed per year is approximately one third of the cost of construction per bed; consequently the amount expended for the upkeep of the hospital is approximately the same for every three years of its existence as the original cost of the building.

We will now take up the different phases of location, construction and equipment. Before treating these subjects separately, however, it might be wise to state that most hospitals are built too quickly, and therefore imperfectly, and in consequence the present only is considered, without serious thought for the future.

There is probably no class of building for which a responsible contractor is so necessary as in hospitals, as so much depends upon the sanitary condition of the building itself.



It must be well erected in all its essential parts in order that everything may fit properly, and that there shall be no cause whatever for extraordinary effort in keeping the institution in good condition. This particularly applies to interior construction.

#### Shape of the Building:-

All things being considered the U shaped plan is the best and one which in time must become popular. The reasons for this are that such a building can be easily ventilated and heated, the relative cost of construction is small for the amount of utility obtained, the size can, if desired, be increased by lengthening the parallel wings and by increasing the number of stories, if the court faces southeast or southwest no wall surface will be without sunlight between eight A.M. and four P.M. It is important, however, that the height of the parallel wings does not exceed the distance between them, and that the length be less than twice the distance between the wings. Unless these precautions are heeded shadows will be thrown which interfere with the proper sunning of the windows directed towards the court. One of the wings may be assigned to men and the other to women, or one or more floors may be assigned to each sex. It may also be arranged to have each floor or each wing assigned to one member of the medical staff and placed under his entire control as though it were a separate hospital. In connection with this subject it should be stated that several storied buildings are better than low buildings because of better and purer air, more sunlight, and freedom from dampness and unhygienic conditions



prevailing at the greater height.

Location:-

The location of the hospital should be chosen in order to secure the following conditions:-

First - An abundance of sunlight.

Second - Absence of noise.

Third - Absence of dust.

Fourth - Absence of smoke.

Fifth - Proper ventilation.

Sixth - Disposition of sewage.

Seventh - Safety from fire.

Eighth - Possibility of future expansion.

Ninth - Accessibility for patients, their friends and for the medical staff.

Abundance of Sunlight:-Unquestionably the first requisite for a hospital is abundance of sunlight. Not only the exterior wall surfaces of the building, but also the ground surfaces around it should have the direct rays of the sun for as long a time as possible each day. In order to have sunlight in each room it is necessary only to have the main axis point north-east and southwest or northwest and southeast. If the hospital is placed on a lot near another building, the distance between the two buildings should be at least twice the height of the taller building, which will permit the presence of sunlight.

While on this subject of sunlight it might be interesting to discuss the orientation of the different types of block plans in respect to sunshine and shadows. Second only to air is light and sunshine essential for growth and health, and it is



one of nature's most powerful assistants in enabling the body to throw off those conditions which we call disease. Not only daylight, but sunlight; indeed fresh air must be sun-warmed, sun-penetrated air. The sunshine of a December day has been recently shown to kill the spores of the anthrax bacillus. Wall surfaces, especially brick walls, absorb a large amount of moisture during rains. This moisture is quickly dried out by exposure to sunlight, but is retained for a long time in walls that are exposed to the sun and creates an unhealthy condition; for dampness, with lack of sunlight, is a combination favorable to the growth of low forms of vegetable life and should be avoided in hospital buildings. To secure sunlight in the fullest measure requires that the general plan of the buildings shall be carefully studied with this end in view.

To study properly the question of sunlight, a "sun plan" of the buildings must be drawn and their positions considered with reference to the shadows they cast upon each other and upon the ground. An astronomical table, showing the path of the sun from sunrise to sunset at the different seasons of the year, is desirable for this work.

The following table gives the number of hours (sun dial time) during which the walls of a square or rectangular building in the latitude of Boston, Mass. are exposed to sunlight at the four periods of the year named.

Building placed squarely north and south.

June 21.

N. Wall- { 4:25 A.M. to 7:45 A.M. }  
          { 4:15 P.M. to 7:35 P.M. } ..... 6 hrs. 40 min.



E.Wall - 4:25 A.M. to 12 M.	7 h.35m.
S.Wall - 7:45 A.M. to 4:15 P.M.	8 h.30m.
W.Wall - 12 M.to 7:35 P.M.	7 h.35 m.

March 21 and September 22.

N.Wall	None.
E.Wall - 6 A.M. to 12 M.	6 h.
S.Wall - 6 A.M. to 6 P.M.	12 h.
W.Wall - 12 M. to 6 P.M.	6 h.

December 21.

N.Wall	None.
E.Wall - 7:35 <del>AM</del> to 12 M.	4 h.25 min.
S.Wall - 7:35 A.M. to 4:25 P.M.	8 h.50 m.
W.Wall - 12 M. to 4:25 P.M.	4 h.25 m.

Building placed at an angle of 45 degrees with the meridian.

June 21.

N.E.Wall - 4:25 A.M.to 10:45 A.M.	6 h.20 m.
S.E.Wall - 4:25 A.M.to 1:15 P.M.	8 h.50 m.
S.W.Wall - 10:45 A.M.to 7:35 P.M.	8 h.50 m.
n.W.Wall - 1:15 P.M.to 7:35 P.M.	6 h.20 m.

March 21 and September 22.

N.E.Wall - 6 A.M.to 9:45 A.M.	3 h.45 m.
S.E.Wall - 6 A.M. to 2:15 P.M.	8 h.15 m.
N.W.Wall - 2:15 P.M.to 6 P.M.	3 h.45 m.
S.W.Wall - 9.45 A.M. to 6 P.M.	8 h. 15 m.



December 21.

N.E.Wall - 7:35 A.M.to 8:45 A.M.	1 h.10 m.
S.E.Wall - 7:35 A.M.to 3:15 P.M.	7 h.40 m.
S.W.Wall - 8:45 A.M.to 4:25 P.M.	7 h.40 m.
N.W.Wall - 3:15 P.M.to 4:25 P.M.	1 h.10 m.

It will be seen that the building placed at an angle of 45 degrees has the better sun exposure,as all four walls have sunlight at some part of the day throughout the year,while with the building placed squarely north and south 25 per cent of the wall surface is without any sunlight at all during one half of the year.

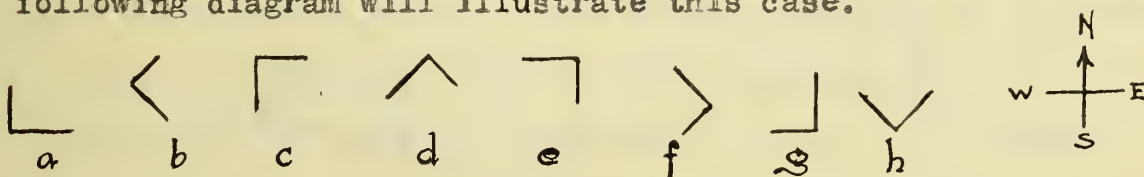
By drawing "shadow plans"of the building placed in the two above positions it is found that a square or rectangular building placed squarely north and south shades the ground area around it considerably more than the same building placed at an angle of 45 degrees with the meridian.

For a rectangular building with its long axis placed directly north and south there will be 12 1/2 per cent of wall surface without sun at any time during the day;with the long axis placed directly east and west,37 1/2 per cent;with the long axis pointing northeast and southwest,none;and with the long axis northwest and south east,none.In the first and second positions there is a considerable portion of the ground to the north of the building which is in shadow from 8 A.M. until 4 P.M. or practically without any sunlight at all during the day;wheras, in the last two cases,with the axis at an angle of 45 degrees, there is no portion of the ground around the buildings which is



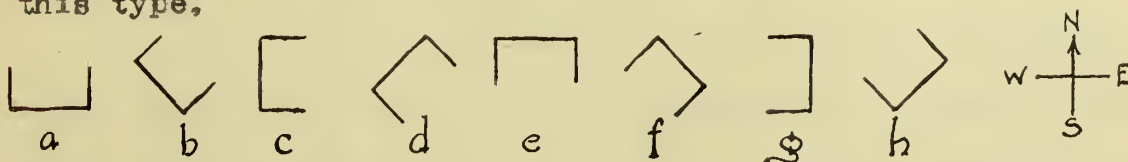
without sunlight. In the first position the windows on each of the long sides have the sun for an equal amount of time during the day, the windows on the east side have the sun during the forenoon and the west windows the afternoon sun. For a pavilion divided into separate rooms, with windows only on one side, this might be considered an advantage. Bearing in mind, however, that the fore noon sun is more prized than the afternoon sun, it is seen that the position with the long axis pointing northwest and southeast is equally as good in this respect as the first position, inasmuch as one of the long sides has the sun from sunrise until 9:45 A.M., and the other from 9:45 A.M. until sunset, each long side thus having a share of the forenoon sun.

The plan of two blocks arranged as an L is a common one for hospitals on the block plan, especially on confined sites. The following diagram will illustrate this case.



The amount of wall surface without sun at any time during the day is - (a)-28 %, (b)-none, (c)-25 %, (d)-none, (e)-25 %, (f)-none, (g)-28 %, (h)-10 %.

As stated previously the block plan with three blocks arranged as a U, giving a court enclosed on three sides, is, all things considered, the best. A diagram will also be used to explain this type.





The amount of wall surface without sun at any time during the day is:-

(a) 27 %, (b) 7 %, (c) 30 %, (d) none, (e) 22%, (f) none, (g) 30 %, (h) 7 %. It will be seen that the best position for this type of plan is either (d) or (f), which are equally good. The worst position of all is (a) because of the large amount of wall and ground surfaces in the court that are without sun at any time during the day.

In the H type of block plan, no matter in what position it is placed, there is a portion of the wall and ground surface without sunlight, and it may therefore be dismissed as an unsuitable type of plan for hospitals.

\*Other forms of block plans may be ~~made~~ made by combining the elementary forms above given, such as the cross plan, which is a combination of two L s, or the E plan, which is a combination of two U plans, and others, but the elements of nearly all such plans will be found to consist of U shape courts enclosed on three sides, or re-entrant angles of L shape, both of which have been investigated in the foregoing discussion.

It is seen from the foregoing discussion that for isolated buildings of all ordinary rectangular types of plan, the location of the main axes of the buildings at an angle of 45 degrees to the meridian yields in all respects a satisfactory sun exposure for the wall and ground surfaces.

In the above discussion we have considered isolated buildings only. In the pavilion type of hospital plan, which consists of a number of separate buildings of various shapes and heights,



either entirely isolated or more or less connected by corridors, the problem becomes more complex, as it is necessary to consider the shadows cast by the different buildings upon each other. A separate and careful study of each case is a necessary preliminary to the creation of a successful hospital plan.

**Absence of Noise:**-The site should be in a quiet portion of the city, away from noisy railroad tracks, street cars or elevated railroads, or noisy factories. The location should be chosen at least three blocks from ordinary railroad tracks.

**Absence of Dust:**-The location should be so chosen as to reduce exposure to street dust to a minimum. This can best be accomplished by selecting a high knoll in a hilly city, or by setting the building back from the street a considerable distance in a flat city and planting trees and shrubs, which will act as natural filters, along the edge of the grounds along the streets, and by erecting high buildings. Very little street dust rises above the second story, so that the higher stories are nearly free from this contamination. It is necessary to have the trees and shrubs far enough away from the building so as not to cause dampness of the soil by a great amount of shadow. It is important to have high basements as they will help to remove the patients farther from the ground; this is because of the unhygienic conditions which come from close proximity to the ground as well as because of the street dust. In every city there are streets which are comparatively little used and this fact should be considered in the selection of a site.



Absence of Smoke:-Locations should be avoided in which there is but rarely any sunshine because of the presence of coal smoke from large furnaces and factories.

Proper Ventilation:-If possible the site should be chosen upon an elevation,as in such a case the building will be constantly exposed to a more rapid current of air than would be the case if it were situated at a low point,especially if the low point is surrounded by other high buildings.Locating on high points would favor natural ventilation,and in case forced ventilation was used,it would be possible to obtain air of much greater purity.If the city is built upon a flat area,great advantage can be obtained as regards ventilation by placing the hospital to the leeward side of a park,or a body of water,in order to have the side from which currents of air approach during the greater portion of the year as nearly as possible unobstructed.If the hospital is placed on a lot near another building the same precautions should be taken as stated for a similar case under the head "Abundance of Sunlight",so as to permit good air circulation.The larger the lot,the purer the air will be ,resulting in a smaller death rate.

Disposition of Sewage:-It is important to give this subject special attention as there is greater danger of contamination in hospitals than in other kinds of buildings.In large cities the sewerage system is usually so well arranged that little difficulty is experienced from this source,no matter where the hospital is situated.

Safety from Fire:-It is well to select a location as far



as possible removed from other buildings as this will prevent a panic among patients in case of fire in the neighborhood. Even in a perfectly fireproof hospital, with no actual danger of direct contact with fire, the risk of a panic is of sufficient importance to demand special attention to this feature in locating hospitals.

**Possibility of Future Expansion:-**Although future expansion can be taken care of by additional stories such a site should be selected as will allow for expansion by lengthening the wings of the building.

**Accessibility:-**It is of the greatest importance to the patients occupying beds in hospitals, as well as to their friends that the institution be located at a point which can easily be reached by them. This will also make it possible for patients who are very ill to be transferred to the institution without great danger of injury from the transportation itself. The same condition will secure for the hospital upon its medical and surgical staff men of the highest skill and ability, who could not spare the time to travel a considerable distance to care for hospital patients.

#### **Construction.**

**Grade:-**When possible the highest point should be taken as inside grade, and the entire lot graded off from this point with a slight slope, in order to give perfect drainage at all times. Where this is not expedient, owing to the necessity of locating the hospital advantageously, it is well to take the highest point within practical limits, and grade the entire



lot to such a point. The primary object should be to afford a perfect drainage away from the building, and to properly facilitate the keeping of the basement in a dry and sanitary condition.

**Excavations:**-Care should be taken in making the excavations that they be sufficiently large to admit of the working on the walls outside, so as to permit plenty of room for the inspection and construction of the damp proofing.

**Footings:**-As far as practicable the footings should be of concrete and put in so that they will adequately bear the building. Damp courses, if used instead of damp-proofed cement coatings, must be built in with the foundation walls, with sufficient projection into the building so that the damp-proofing of the floor and that of the walls will be continuous.

**Foundations:**-It is probably necessary in a hospital more than in any other building that the foundations should be correctly built. They should be built of concrete or of stone and the utmost care should be taken to see that they are thoroughly damp-proofed, especially on the outside, so that none of the soil gases or dampness can penetrate them.

**Exterior Material:**-The material for the superstructure should be such as will best carry out the design of the building, which should be as neat and as artistic as possible, but under no circumstances should the latter be made the primary purpose in the construction, rather the design should be subservient to the material of which it is best to build the hospital. It is wrong, however, to suppose that environment, especially



the exterior of the building, has no effect whatever upon the patient. For a hospital well located with lawns and ~~trees~~ about it, and having the general appearance of a homelike institution, or even a large residence, will often attract people who would under no other circumstances go to such a place. It has also its mental effect upon the public at large. It has been found that the material best suited for the exterior of hospitals is brick, with terra cotta trimmings, but stone, terra cotta and even cement, the latter in either reinforced work or in blocks, or a combination of all, can be used. Paving brick can be used with a greater degree of economy and with better results for tight, non-absorbent walls than almost any other material. These should be laid in cement mortar and not more than eight feet in height to each length of wall, as there is liable to be a decided slip-page if there is too much weight. The masonry, of whatever material should be the best and the cheapest, damp resisting and of an artistic appearance. The outside if of stone or brick, other than paving brick, can be treated with specially prepared washes to prevent saltpeter stains and to waterproof the material.

If the outside walls are of brick, stone or terra cotta the inside of them can be furred with hollow tile, hollow brick, or concrete blocks, but none of these methods is one absolutely sure of preventing saltpeter spots on the plaster which is put directly on them. This could be avoided, however, by putting on furring and metal lath or by applying compounds especially prepared for the purpose.



### Damp-Proofing:-

To prevent moisture from coming through the walls a double coating of one of the damp-proofing compounds should be put on before the plaster ring is done, the plastering forming a permanent bond over the application. Care must be exercised so that none of the so-called damp-resisting paints or damp-resisting methods be applied, unless they have been thoroughly tested for their permanent elasticity and their ability to withstand gases if those with felt are employed. The roof side of a parapet wall and the under side of the roof should also be treated with a damp-resisting compound. In this way an almost continuous damp-proofing is put on the walls.

### Furring:-

All furring should be of a fire proof character. Hollow tile, concrete blocks, or metal strips can be used. The hollow brick now on the market is little or no better than the ordinary <sup>common</sup> brick so far as furring is concerned.

### Chimneys, Flues and Ventilating ducts:-

Great care should be exercised in the construction of chimneys, flues and ventilating ducts. They should be carried well up so as to create the necessary drafts and so that the discharge from them will be diluted at as great a distance as possible above the habitable parts of the building. The chimneys from the boiler room should be built for at least forty or fifty feet of their height above the boiler with fire brick, and under all circumstances should be built with an air space from top to bottom. This space can often be used for the ventilation of the boiler



room. In the case of vents the plastering of the inside of the vent flues is sufficient for all purposes.

#### Fire Proofing:-

The first requisite in the construction of a hospital is that it shall be absolutely fireproof in every detail. Fire proofing in hospitals should mean all that the word conveys. Tile floors and tile partitions, concrete floors and partitions, or partitions made of steel studs and furring with expanded metal lath and hard plaster, when properly made will apply to all possible problems which could arise. Tile is the most practicable material because of its lightness and the great resistance it offers to fire. Columns and other steel or iron work should be protected with tile or concrete. Cinder concrete should not be used for this purpose as it disintegrates the metal. Tile should be set with an air space between it and the metal. All tile and concrete should set close to walls and ceilings and around pipes and other openings.

Metal clad doors, all-metal window frames and sash, and wire glass should be used. This glass is reinforced by the wire and is less liable to breakage than ordinary glass and even if broken will be held in place by the wire.

Fire proof paint can be employed to advantage in painting shelving in store rooms.

Fire proof wood, wood that has been impregnated with specially prepared chemicals, can be used for floors and inside finish. Wood of this kind while not absolutely fire proof, is acted upon slowly by fire and is a means of retarding the same.



### Floors:-

The supporting floors should be of hollow tile, concrete, or a combination of the two, supported by structural iron I beams that are encased in concrete or hollow tile.

The best material for the finished floor in wards is properly finished and seasoned maple, closely and carefully driven together and securely nailed. This wood should be impregnated with specially prepared chemicals to make it fire-resisting. This finished floor should be nailed to beveled wooden strips, that are thoroughly impregnated with a fire-proofing compound, thoroughly creosoted, and firmly imbedded in concrete. The space between these strips should be filled with deafening of mineral wool or cinder concrete. The latter, however, has the disadvantage of disintegrating any pipes with which it comes in contact. If cinders are used all pipes should be protected with a coating of neat cement. It is of the utmost importance that these wooden strips be laid with the greatest care so as to avoid unevenness and creaking. There should be no thresholds or differences of level on the same floor.

Finished floors for all rooms, except wards and laundry, should be made of vitreous tile laid in cement, or of water proofed flake mosaic. These floors are impervious to water and oil. Glass is very good for operating rooms but has the disadvantage of chipping easily. The laundry floor should be of concrete with a waterproofed cement top. The floors of kitchens, operating rooms, and laundries should be provided with a drain or gutter.



#### Floor Coves:-

The connection between the floor and wall should be of cove form throughout. This is to guard against the collection of dust, dirt, and micro-organisms, as there are no sharp angles and corners to collect the same, and the coves can be mopped as readily as the rest of the floors. These coves can be made of wood, cement, marble, tile, glass, slate, and composition, but the cheaper materials are as good as the more expensive ones. The joints of the cove with the wainscoting and floor should be tight and carefully made so as to avoid the collection of dust.

#### Ceiling Coves:-

Coves at the angle made by the ceiling with the wall are not necessary as the accumulation of dust in this angle is slight. Where pressure systems of ventilation are used, coves might be advantageous, but even under these circumstances they can be omitted. They are expensive luxuries at best.

#### Wainscots:-

The wainscot in halls and in corridors is best of marble although except for their looks cement and tile are just as good. In operating rooms and their corridors the wainscot should be of mild white glass, which is impervious and acid proof. In operating rooms it would be best to have the entire walls of glass. In the kitchens, nurses' rooms, and laundry department cement wainscots are best. In the toilet and bath rooms marble, slate, soap stone, or glass could be used, the latter being the most desirable. The partitions in toilet and bath rooms are made of the same material as the wainscot and should be made in such



a manner that the entire floor is as nearly clear of obstruction as possible. This is done by supporting them on nickled brass or white metal standards.

All wainscots should have rounded corners.

**Inside Finish:-**

There should be no angles in the wood work and no beams in the ceiling because of their dust collecting qualities. As small an amount of woodwork as possible should be used and the whole interior should be designed and constructed with as few places for dust to lodge as possible.

**Trim:-**

For its fireproof qualities metal clad wood should be used for the inside finish. If plain wood is used it should be close grained and well filled and enameled.

There should be no wood sills. Either a splay, with a corner bead around the entire window, should be used or a flat marble or slate sill not less than 1 1/4" in thickness.

There should be no base.

**Doors:-**

Doors should be metal clad and without panels. If transoms are used they should be of wired glass with metal clad frames and hung in such a manner as to close automatically. The jambs should be splayed and no door frames used. If frames are necessary in some cases they should be metal clad and perfectly plain. Doors should be wide enough to allow a bed to be rolled through. It is absolutely necessary that double acting doors be employed in every possible instance. These leave one's



hands free for other duties and prevents the hands from being contaminated by contact with any organisms that might be on the surface of the doors. There should be a glass panel in the upper portion of all double acting doors to give warning of persons on the other side.

Windows:-

The window sash should be all-metal or metal clad hung with chains or steel tapes over smooth running pulleys that are not less than 2 1/2 inches in diameter. These pulleys should be pin-bearing or ball-bearing so as to avoid squeaking. Above the second story all windows should be of such a type as will allow them being cleaned from the inside.

Cases:-

Cases for pantries, kitchens, linen closets, instruments, and medicines should be of the "knock down" variety of the simplest kind, and should not be in large sections. This allows of easy cleaning from inside and outside and change in arrangement. It would be a good plan to construct these cases on the expansion method.

Stairs:-

The stairs should be fireproof and made of reinforced concrete, tile, or entirely of iron. The treads should be finished in flake mosaic, slate, or patent safety treads. The treads of the tile stairs can be left as they are. Hand rails should be placed on both sides and securely fastened to lugs. The stairs should be enclosed by a fire proof well made of brick, tile or concrete, having no openings but the windows to the outside and the doors into the corridors. Both *the* windows and doors should be metal



or metal clad and the glass which they contain should be wired glass. All stairways should be constructed so as to have outside light. Stairs should have easy runs and this can be accomplished by providing landings. No winders should be used and the stairs should be at least six feet wide.

#### Elevators:-

For institutions containing up to 150 beds one elevator is sufficient, for a larger number two should be provided, one for patients and one for freight. All elevators should be equipped with stopping and starting devices which give perfect control of the car. The best and safest elevator is hydraulic, of the plunger type. This is operated by a piston, lifting directly under the elevator and extending as far into the ground as the elevator rises above ground, thus preventing the car from dropping. Elevators should be enclosed in wells similar to those for stairs.

#### Fire Escapes:-

Fire escapes should always be provided for hospitals over one story in height. They should be made entirely of wrought iron, and have balconies properly supported, either from brackets or from floor to floor, depending upon their size.

#### Skylights:-

Skylights should be so constructed that they will exclude all condensation and they should face north only, so as to receive the steady north light. The sides and top should be built of tile or concrete, and the skylight should be made double in all of its parts, so as to exclude all condensation.



Wire glass should be used for the outer glass and clear plate for the inside. The wire glass should be set in angle iron doors so as to permit of cleaning both sets of glass.

#### Safes and Vaults:-

Safes and vaults should be provided in all hospitals. There should be a vault with a safe in the main office, and in the basement supporting this a storage vault for back records and account books. Vaults should rest on their own foundations and should be constructed with two walls, with an air space between, of good hard brick laid in cement mortar. The doors should be on both the inside and outside edges of the wall, so constructed as to be practically air tight.

#### Painting and Enameling:-

Enamel is the best material with which to treat all walls above the wainscot and ceilings as it is easily cleaned and absolutely sanitary. Because of the reflection of light, which is trying on the eyes of the patients, no glass enamels should be used except in kitchens, diet kitchens, and operating, sterilizing, toilet, bath, dressing, and anesthetizing rooms. Except in the above mentioned rooms white should not be used as it gives a cold appearance to the room. Soft gray, buff or delicate green are good tones for wards, and ivory or buff for corridors and halls. No enamel which contains lead should be used, as it deteriorates quickly, turns yellow and cracks. Varnish can be used on the trim but is not as good as enamel, as the latter is more elastic and is not effected by antiseptic solutions.



### Plumbing:-

The entire system of sewerage, supply and installation of fixtures should be generous in size and simple in installation and operation. All pipes and supplies should be generously valved, each valve marked by brass tags giving the location of fixtures on each main and each branch, or should have a numbered tag and a chart conveniently placed. There should be uniformity in all piping, so that corresponding pipes have the same relative location. All risers should have besides the valves mentioned a check valve, so as to avoid back pressure, and in cross connection should have gate and check valve put on. Each supply at each fixture should also be properly valved, so that any supply at any fixture may be turned off without interfering with any other supply. In this manner the whole system, any part of the system, any set of fixtures, any fixture, or any supply on such a fixture can be closed, and the water turned off without interference with any other part of the system or fixture respectively. Directness and simplicity of system are the first essentials in plumbing requirements.

### Water Supply:-

Only the purest water should be used and if this is not directly obtainable, a system of filtration, sterilization and distillation should be installed. The primary requirements for the water supply are sufficient water at all times for all purposes; fixtures of the open type, either in enameled ware, porcelain or vitreous ware; waste pipes calculated as to size so that they will be self cleaning, but not so small as to not fulfill all requirements; ventilation of rooms, fixtures and the



system; good joints in good quality pipes, and pipes that will not corrode; a system that is water tight, gas tight, and which is so installed that it will drain perfectly at all times, and one which is securely installed; one which will work perfectly so that there will be no interference of one portion with another; which is noiseless in operation and which is accessible in all its parts throughout. In multiple storied hospitals if there is not sufficient pressure from the water mains to give an adequate supply of water to the upper stories, storage tanks should be installed. If the lower floors are supplied direct, provision should be made so that in case the water from the street main becomes insufficient, the supply from the tank will automatically give a supply of water to such floors. In hospitals of three or more stories there should be provided shafts for the carrying of pipes. These shafts should be made of such size that all parts of their contents are accessible, and should be so constructed that they will open from floor to ceiling with hinged doors at their points of access.

Sewer:-

The house drain should never be of tile as the joints cannot be made tight and the tile is subject to injury in many ways. Extra heavy iron pipe should be used for the sewers as it is not subject to breakage at the joints nor in the pipe, all joints are both water and gas tight, frost will not injure it readily, the inner surfaces at joints are not subject to obstructions, and it can be run in proximity to water supply without deleterious effects.



### Subsoil Drainage:-

Where there is a condition of dampness or a water level, which would keep the foundations and probably the basement floors damp, subsoil drainage should be put in. Subsoil sewers should be placed about the entire building in such a manner that the water which flows into them may be readily carried off. These drains connect to catch basins properly trapped, or to the invert or lower portion of the main street sewer.

### Gas Fitting:-

Gas pipes should be laid on the tile or concrete of the floors, and deafening put in over them if wooden floors are laid, or bedded in cement, when the floors are finished in materials other than wood. From the meters to all outlets the piping should be properly proportioned so that the system is positive and noiseless. As in water supplies, it is best to run pipes from manifolds, or to take the supply for each floor from a main riser which is placed in the pipe and wire way provided. The system in mains and branches must be proportioned so that there will be no diminution in any lights when other lights, or all lights on a floor, are turned on. There should be a shut off at a point outside the meter, and also one on each floor for the entire floor, so that the gas on any floor may be turned off without interfering with the lights on any other floor. All connections between pipes and fittings should be made by screwing together with linseed oil so as to insure a tight joint. The openings should all be capped with iron caps, screwed on, and the



whole system tested by air pressure. Fuel gas should be run separately from illuminating gas, and should be entirely independent of the latter. It should have its own meter and stopcocks and should be run in the same manner as illuminating gas. The piping should be run direct for the main kitchen, baking room, special diet kitchen, and for sterilizing apparatus. Besides the cock for shutting off the supply to the burners of such fixtures, there should be a stop cock on the supply pipe to shut off the gas from the entire fixture, and one to shut off the supply from each group of fixtures. Diet kitchens should be equipped with fuel gas for stoves and also with a cock for hose connection for a Bunsen flame burner. In the laboratory taps for Bunsen burners should be supplied. There should be a shut off for each run, one for each individual burner, and a general shut off for the entire laboratory so that the supply of gas can be turned off from this room without interference with any other part of the hospital. Provision should be made in the laboratory for the supplying of special apparatus with sufficient burners for this portion of the equipment.

The placing of separate shut offs on each group, and on each run and fixture of such groups throughout the building cannot be too strongly advocated. A slight leak in a pipe under such circumstances does not necessitate the shutting off of the entire gas supply in the building, as is the case where the cocks are omitted and repairs are necessary. Moreover, one part of a group can be shut off in any room without interfering with the remainder of the work in that room.



### Heating:-

Heating may be done by one of two methods - hot water or steam. The primary principles for these are practically the same namely, that there should be sufficient radiation for each and every space to be heated. An excess of radiating surface is to be desired at all times rather than "just enough", or too little. Hot water, however, is more to be desired than steam as it is more economical, more quickly brought to the desired temperature, and will *maintain* heat over night without additional firing. In either steam or hot water the main object to be reached in the installation is to have sufficient capacity in all parts of the apparatus, a quiet and positive working system throughout, and economy at the boilers when once the system is installed. The pipes should be sufficiently large to do the work <sup>noiselessly</sup> and positively. The boilers, of whatever type, should have sufficient capacity to easily take care of the radiation with an excess added, whose minimum should be at least 50 per cent greater than the radiation supplied. The system should be controlled by thermostats so as to regulate the heat in changes of temperature.

For wards, private rooms and the operating room the fan system of heating should be used as this provides for the large amount of air necessary for ventilation and has the advantage over direct radiators in having no dust collecting surfaces. In the wards the air should be brought in under the windows, the registers being put in every pier or every other pier. The position of the register in such a location should be high enough above the floor to prevent the register box from becoming a dust



receptacle, and low enough below the window sill to issue the air sufficiently near the floor to prevent coldness at the floor level. The heat must be uniform and thoroughly under control in the coldest weather, day and night, so as to be available in the case of emergency operations.

In direct radiation the radiators should be selected with due reference to plainness, smoothness and accessibility to surface for cleaning. All radiators should be placed next to exposed walls and as near windows as possible, as these are the coldest portions of the room. In operating rooms the effect on the patient of the large exposure of chilled window glass should be compensated by a correspondingly large heated surface. That surface may be in pipe form, carried about the window frames and over mullions and other parts of the framework, in a manner to be neither conspicuous nor light intercepting. When the windows are double glazed and with ample air space between the plates, that space, and with it the inner glass, may be warmed by pipes concealed from view within the space.

#### Ventilation:-

The two considerations of the state of susceptibility of the body and the time of duration of exposure, conspire in the demand for a more free ventilation of hospitals than of any other class of buildings. Of all places, the hospital is the place for maximums in all that can increase air. The rule of ventilation should be "the maximum admissible, rather than the minimum tolerable". For surgical wards a maximum of 6000 cubic feet of air per hour per person should be supplied and in



medical wards, because of an absence of moribific quality in the atmosphere, the maximum can be placed at 4000 cubic feet. If there are infectious wards they should receive a maximum of 8000 cubic feet. The air in the rooms should be kept as nearly as possible of the same quality as the exterior air and the temperature should be kept at 68 degrees to 70 degrees F. Operating rooms should be maintained at a higher temperature. In a hospital the risks of contamination of the air, and of the impregnation of the materials of the building with morbid substances is very great and the greatest care is necessary that hospitals shall not become pest houses, and do more harm than good. The risk of transference or aggravation of disease is least in the best ventilated hospitals. A great supply of air, by immediately diluting and rapidly carrying away the morbid substances evolved in such quantities from the bodies and excretions of the sick reduces the risk to the minimum and perhaps removes it altogether. Proper ventilation will lower the mortality percentage, as well as decrease the average time to obtain a cure, which in turn will increase the working capacity of the institution. As an example - at the Smith Infirmary on Staten Island, two wards were taken, one with and one without ventilation. The patients admitted to each ward were of the same class and suffering to a great extent from the same diseases. The results obtained were that the patients in the ventilated ward averaged ten days to effect a cure, while in the unventilated ward the average was sixteen days.



Operating, mortuary, etherizing, bath, and toilet rooms, kitchen quarters and lockers require the so-called "vacuum ventilation". This system is so arranged as to prevent the escape of air from these rooms to other rooms or corridors connected with such rooms. This is to protect others who are not occupying these effected rooms. Such ventilation, to be effective, must isolate the above rooms, atmospherically, from their surroundings.

To accomplish such a result the provided discharge ventilation must be in excess of the provided supply ventilation. The major force operating to ventilate these rooms should be on the side of discharge rather than on that of the supply. The air of corridors and adjacent rooms would then tend to move toward and into the vacuum ventilated rooms, rather than from such rooms into surrounding quarters. Other sections of the hospital than those above mentioned should have a greater strength of ventilating work on the supply rather than on the discharge side. Such ventilation should be furnished to all wards, private or general, and for all living, administrative, and work quarters, other than those named. By maintaining a condition of lower atmospheric pressure in those parts of the hospital which should be atmospherically isolated, and by maintaining at the same time a higher pressure in those parts which should be protected, the trend of air movement is made to set from the quarters in which the air should be maintained at its purest, toward and into those in which, from one cause and another, the contained air must of necessity, and may without harm, be more or less contaminated by impurities which vary from the dangerous to the offensive and



to the relatively innocent. The above methods should also be applied to special quarters, such as toilet rooms and kitchens so as to confine odors, smoke, etc. to the place of their origin, and to remove them without allowing them to mix with the air that is used for breathing. The general law governing these matters and applicable to all ventilating work, and designed to insure effectiveness and economy in that work, is that of limitation and removal by saturation, as against diffusion and removal by ~~by~~ dilution. The windows of wards, living rooms, dining rooms, in fact almost all quarters of the hospital, should be provided with transoms, so that the rooms may be flushed with an in-flow, through-flow and out-flow of outside air. Such transoms should be furnished with checks to prevent a lateral inflow of air and to insure an upward flow only, so as to reduce floor drafts to a minimum. If it is desired to have continuous natural ventilation, but much more limited in degree than that by the transom method, it may be obtained by placing so-called natural ventilators, which are oblong metal hoods provided with openings with or without shutters, into the windows or into the walls, under the windows. In all forms of natural ventilation it is necessary to have some outlet for the air in the room in order to create the circulation necessary for ventilation. The doors should be provided with transoms, as the corridors can thus be made large and voluminous vent ducts, which would be more than sufficient for all ordinary needs, so far as the quantity of air to be conducted is concerned. If this is done, however, it will be necessary to place at the opening of each corridor some adequate means for carrying off the air which would come into



the corridors through the transoms. This can be accomplished in several ways - namely, the creating of a slight draft by means of a radiator placed below the windows, and the use of some form of screen work, or a number of ventilators, at the top of the windows, or ducts built through the walls above the windows. This will also serve the double purpose of keeping the air in such corridors somewhat purer, and at the same time keeping them at a temperature such as will be required.

In designing the ventilation care should be taken that the air employed is evenly distributed and diffused. Preference is to be given to a diffusion of supply and to a concentration of discharge, because of better distribution and less drafts. The most convenient, as well as the most effective, place for the inflow of air into wards is beneath windows. The concentration of discharge could be through a large fireplace or flue at one end of the room. For each twelve beds there should be not less than six inlets and not less than one ample and well located outlet placed near the floor. The depressed condition of the vitality of the patients makes free ventilation imperative.

At times the temperature of operating rooms becomes oppressive from overheating and from anaesthetic fumes. Quickness of air change is then called for. This change can best be effected by giving strong exit to the air of the room from its ceiling, where air is hottest and vapors densest. At ordinary times, however, the air is discharged at, or near, the floor. If the room is of the amphitheatre type, accommodating a large number of clinic observers, a fan of suitable size and power to meet the

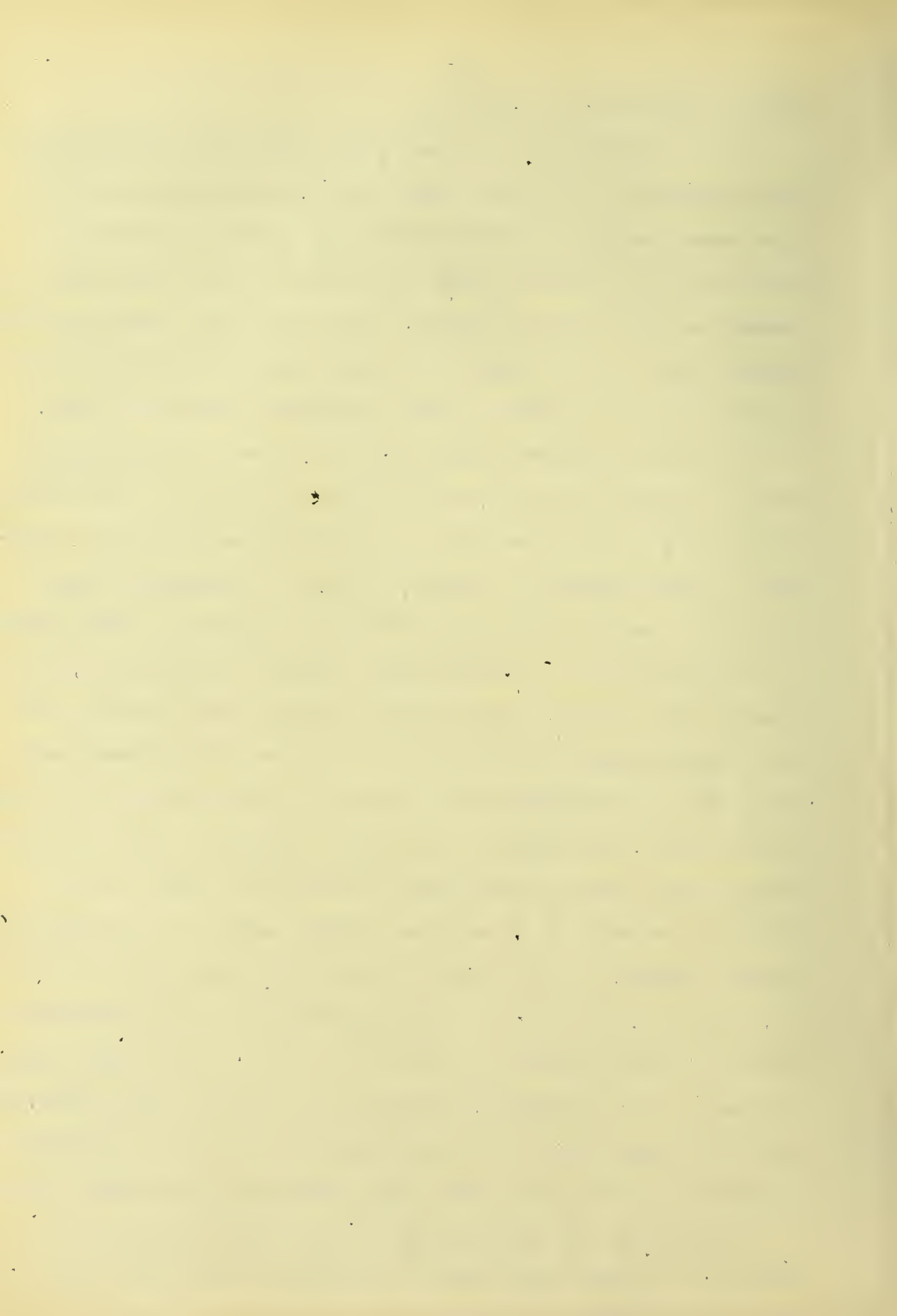


special conditions is required.

It is important that airways, both supply and discharge, be kept scrupulously free from dust and dirt. Cleanliness is the first essential; to it ventilation is secondary. As far as is practicable, all airways should be accessible for the purpose of inspection and cleaning, and for this reason the mouths, throats and duct-ways of flues, both for supply and discharge, should be as open and as accessible as are fireplaces and their flues.

In hospitals, where ventilation is to be continuous; where the air volumes are large; where air-ways are long, or small, and the velocity of air flow must be high, the conditions are favorable to, and frequently require, the use of mechanical ventilation. Fan ventilation is, therefore, to be generally recommended for large hospitals of complicated plan and construction, where airways must be small, tortuous and long, and where gravity can not be given generous provision for its own moderateness and variableness of work. When fan systems are used the air for ventilating should be washed by passing it through a wall of finely sprayed water. Before being passed through the water the air should be conveyed to a settling chamber, where it is permitted to come somewhat to rest, thus allowing the larger dust particles to settle out. This room is best located in the attic, because of danger of contamination of the air by soil air and other gases if placed in the basement. It should be large and kept clean, and should be lined with tin or galvanized iron, or built entirely of sheets of *the* latter with tight joints and stiffening rods.

In forcing the ventilating air into the building it is possible to select that which is relatively free from dust by



placing the opening of the intake at a good height above the roof, but in such a position that the prevailing winds will force the impurities which come from the chimneys and vent pipes away from the intake.

#### Refrigeration:-

For refrigerating purposes, the mechanical or artificial method is much better than the natural method, because of the better preservation of food products and the freedom from poisonous germs. For the preservation of perishable goods, the temperature is the chief factor, but other conditions, such as clean, dry, well ventilated rooms and pure air, are at times almost of equal importance. Humidity is of almost as much importance as temperature at times. A cold storage room should not be too dry, for if so, it will favor the drying out of the goods and their shrinkage. If the moisture is kept below the point of saturation the best results are obtained.

There are several systems of mechanical refrigeration now in use but it is very generally conceded that the compression *ammonia system* is by far the best. In this system the liquid ammonia is allowed to expand in pipes placed in the rooms to be cooled and in process of expansion absorbs the heat.

The proper insulation of buildings and rooms for cold storage is a matter of greatest importance if ultimate economy is to be considered. Without good and heavy insulation greatly increased refrigerating power must be used. If it were possible to construct a perfectly insulated room for cold storage, the refrigerating machine would have but little to do after the temperatures were once produced, except to abstract the heat from



foods when they were first put into the rooms. In constructing these rooms solid walls, especially of brick or stone, must be avoided. Solid walls or partitions are continuous conductors of heat and moisture. Dead air spaces, filled spaces, tongued and grooved boards and insulating paper are essential to satisfactory insulation. This paper should be durable, water-proof, vermin proof, non-combustible and odorless and not porous or spongy. All openings, such as doors and windows, should be as air tight as possible. The doors should be light and with the edges fitted to overlap the jambs. Windows should be few, and if any are used they should be triple glazed. An anteroom should be provided as an entrance to cold storage rooms.

#### Illumination:-

In the illuminating of hospitals, although gas should be provided for emergencies, electric lighting should be used, because of its convenience, absence of odors and the absence of unhygienic qualities in the heat it gives off. In the illuminating of all the rooms the following requirements should be observed:-

1. Sufficient light to enable one to see clearly and distinctly.
2. Avoidance of too much light, which produces a blinding and fatiguing effect on the eye.
3. Avoidance of having a bright light in the field of vision, which cuts down the ability to see clearly things which are less brilliantly illuminated.
4. Avoidance of streaks or striations.



5. Avoidance of flickering light.

6. Avoidance of regular reflection, which is commonly known as glare, due to the light striking an object at such an angle that a large part of the light is reflected directly into the eyes.

7. Avoidance of too sharp contrasts, such as, for instance, a brilliantly lighted desk with the rest of the room in darkness.

8. Uniform illumination in preference to a considerably stronger but less uniform intensity.

In wards there should be plenty of light for the nurses to work by and the light should not shine in the eyes of the patients. The best method is to use inverted brass or spun glass bowls suspended from the ceiling and placed down the center of the room, and which reflect the light to the ceiling and from there to the room. This gives indirect illumination and prevents the lamps from shining in the eyes of the patients. These lights should be supplemented by individual lights, equipped with a reflector and a frosted globe, placed between each bed and so arranged by means of a receptacle and detachable plug that they can be removed when desired. These plugs should be uniform so that any lamps in the *h*ospital can be used. They also serve for the electric warming bags and electric fans. These individual lights are for the careful examination of patients by the doctors and nurses, and if so desired, <sup>enable</sup> the patients to read in bed. Each one should be mounted on a stand and have a flexible stem so as to be placed in any position. They should be equipped with lamps of the multiple pattern, allowing them to be turned



on fully, in part, or shut off altogether.

The lighting of operating rooms should be so arranged as to give a high intensity of illumination, freedom from shadows, the gr<sup>e</sup>atest possible degree of diffusion and a minimum radiation of heat. It is also desirable to have a light that will give the true color to normal tissue. The light should be arranged so as to collect as little dust as possible. The best light for operating rooms is obtained with the Moore tube. This consists of a glass tube of convenient diameter and of any desired length, having electrical conductors hermetically sealed into the opposite ends and the air within exhausted to such a degree as to bring it to the point of conductivity for electric currents of available pressure. The passage of the current raises the rarefied gases to a state of incandescence. The continuous glass tube is placed around the room at about the height of the picture moulding, and, therefore, out of the direct line of vision. This light is the best for operating rooms because the intensity of the light can be regulated from a faint glow to twenty or more candle power per foot, the light is well diffused, the eyes are not inconvenienced, the heat is greatly reduced, and because it perfectly imitates natural light, which is the best light for operations. Hand lamps attached to ~~the~~ wall sockets should also be provided for the use of the surgeons and their assistants.

The lighting of the remainder of the building should be studied as carefully as for the wards and operating room. Corridors can be effectively lighted by chandeliers placed at proper intervals so that there will be no dark spaces between.



Lights should be placed in all closets and locker rooms.

Holophane globes should be used whenever possible because of the good diffusion they give, their small absorbing power, and their property of directing the light in the required direction.

The wiring to all outlets should be done to flush outlet boxes, so adapted that the fixtures can be supported from them. Circuits should be so arranged that lights on them are not scattered - namely, the lights on any circuit should not supply corridors and sundry rooms, but should be concentrated as closely as possible. Corridor lights should be run, if possible, on alternate circuits, so that if one circuit supplying the corridor is inoperative for some reason, alternate lights will still be burning in such corridors. What is required is an independent outside supply for such corridors, so that in case all lights went out on the regular supply, the corridor lights would still be in service, and so facilitate the travel of the nurses from room to room to light the gas. The lights in the operating department should also be put on more than one circuit.

#### Equipment:-

We will now discuss the different fixtures and apparatus with which the hospital should be equipped. In selecting fixtures for hospitals it is highly essential that only those be installed that have been found to be specially fitted for their ultimate purpose, and which may be accomplished without sacrificing their artistic effect. While in no way disparaging the effect toward sightly and artistic installation of fixtures, showy fixtures put in with these objects in view are to be discouraged. There are two tendencies which are equally bad -



the one results in show without utility,gr<sup>e</sup>atly increasing the cost of keeping clean;while the other is to secure only utility, and to make every detail absolutely plain,giving the institution a prison-like appearance that repels the very class of people that should be attracted and that can be most benefited if attracted.The main object to be *attained* is the placing of inexpensive,thoroughly practical,handsome and efficient fixtures, which can be easily cleaned and controlled.

Kitchen:-

The general kitchen should be provided with a *large* range for cooking the ordinary food,steam-jacketed kettles for cooking vegetables,a steam-jacket serving table with a hot water pan,coffee boilers,closets for keeping dishes warm,and work tables.In the scullery should be placed sinks for washing pots and pans,sinks for washing vegetables and a work table.The Sink for the pots and pans should be made of enameled iron,should be supplied with hot and cold water through extension faucets which extend over the sink about eight inches from the back edge, should be connected to a grease trap,and provided with a drain board of enameled iron,slate or well seasoned ash with an enameled joint.The Vegetable Sink is made of porcelain and is divided into three compartments,the central and deepest one being used for washing the vegetables,one of the others which is shallow is used to hold the cleaned vegetables,and the last is used as a sort of drain for the central portion.

The Special Diet Kitchen should be equipped with an enameled iron sink with sufficient drain board,a warming table,



working table, and a number of small gas stoves for preparing special diets.

The Diet Kitchens on each floor should be provided with a gas stove, a steam-jacketed warming oven, a coffee urn, an enameled iron sink with a drain board, a work table, and a small ice box.

The Bakery should be supplied with portable ovens with all the necessary equipment for baking, an enameled iron sink with a drain board, mixing table, dough troughs, flour bins, and working table.

The Butlers Pantry should have cases, shelves and drawers for linen, dishes and silverware, and a sink of planished copper with a copper drain board and equipped with Fuller pantry faucets.

All Ranges, Gas Stoves, and Steam Tables should be built with ventilated hoods. The range in the general kitchen should be placed in the centre of the room, so as to be accessible from all sides.

#### Laundry, Ironing Room and Drying Room:-

The laundry should be so equipped as to eliminate as much hand labor as possible. No part of the hospital needs greater care as to arrangement and equipment than the laundry, for upon this department depends to a great extent the cleanliness of the institution. In equipping a plant it is always advisable to ascertain the capacity of various machines and their operation. The laundry should be provided with as many ventilating shafts as possible, at least two, one being absolutely necessary for modern dryers and the other for the room ventilation.



The equipment should consist of a Sterilizer for disinfecting all classes of hospital goods,so installed that one end is in the soiled linen room and the other in the laundry,making it necessary that all goods pass through it;Washers made entirely of brass or with brass cylinders and galvanized shelves,so as to be the most sanitary and stand hard usage;Extractors to extract the water from the goods after they have been washed; a galvanized iron round Soap Tank for saponifying to a liquid the chip soap that is generally used;stone or enameled iron Wash Tubs of not more than three sections,furnished with hot and cold water,and one section with a brass boiling pipe to boil water,with running wastes or individual tub wastes;Starch Cookers for cooking starch and keeping it hot for a long time; Dry Rooms built in sections and put together in cabinet form, of all-metal or of wood lined with asbestos and block tin,and provided with a steam trap to keep the pipes hot and clear of water;a Mangle with a heat cylinder,high steam pressure and an automatic apron feed;a Body Ironer;Ironing Boards built on iron bases equipped with sleeve boards,and if gas heated irons are to be used,fitted with sad iron heaters;Irons,preferably electrically heated because of their economy and cleanliness;Bleach and Bluing Jars;Scales,Graduated Glasses and Measures,as the work in the washing and starching departments should be exact;galvanized iron pipe Curtain Stretchers having adjustable corner sockets,or Curtain Trucks which can be moved about;and in all hospitals where the amount of work so requires,a Tumbler to shake goods and to remove all lint,and an Ironer for collars



and cuffs. Nickle plated brass should not be used for fixtures in the laundry, owing to the steam and dampness in such places, causing corrosion and the constant care necessary to keep the nickleplating looking bright.

The tubs and washers should be placed directly over the Gutter in the floor and all other machines should drain into the gutter by means of iron pipes laid in the floor. No machines should ever be connected directly to the sewer proper, as some article might get into these pipes which could not be readily removed. The Sewer Outlet should be protected by a screen to prevent lint and other substances from stopping up the pipe.

The first essential of an economically operated laundry is the Steam Supply. Modern laundry machines require high pressure and in putting in a boiler for this purpose it is advisable that it have high pressure of not less than forty pounds and not necessarily over one hundred.

A liberal supply of Hot and Cold Water should be furnished, and in all cases should run through galvanized iron pipes of from one and one half to three inches in diameter, depending upon the number of machines to be ~~run~~<sup>supplied</sup> and the amount required for them.

Direct Connected Motors should be used on each machine as in this way power is used only when the machine is in operation, there is ease of operation, and absence of noise, dirt and danger caused by running belts.

#### Toilet Rooms:-

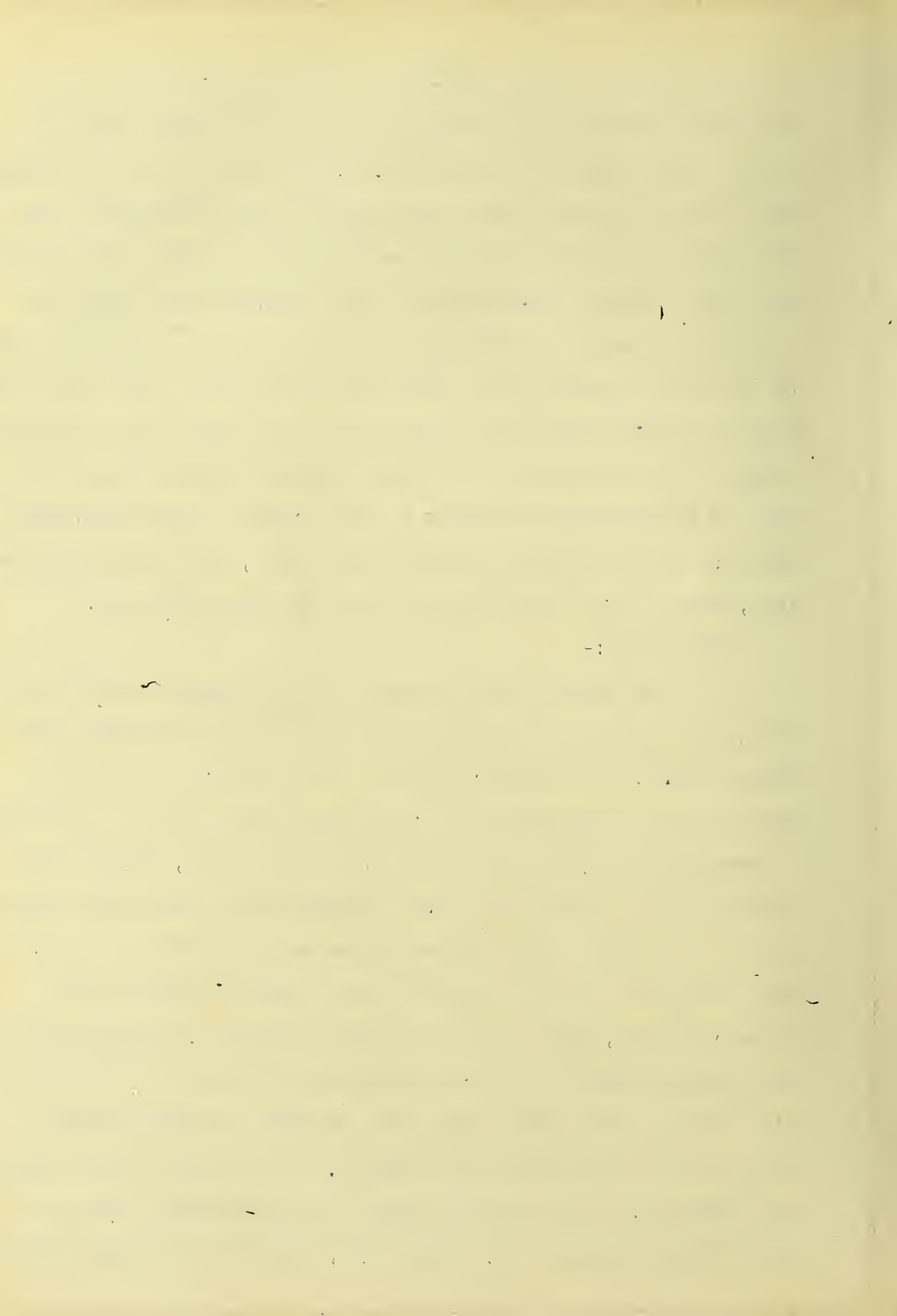
Toilet rooms should be equipped with lavatories and



individual water closets. Lavatories should be used *only* in toilet rooms and private bath rooms. They should be of vitreous ware as this is absolutely non-absorbent and exceedingly durable. If these fixtures are placed against the wall they should be of the integral type, in which the back, slab and bowl are cast in the same piece. The Water Closets should <sup>be</sup> siphon jet and for sanitary reasons they should be of the wall type which set completely free from the floor and close to the wall and should be set into the wainscot. The water closets should invariably be made of vitreous ware because of its sanitary qualities. While enameled iron seats are the most sanitary, they are objectionable, owing to the fact that they are exceedingly cold.

#### Bath Rooms:-

The general bath rooms should be equipped with bath tubs, slop sinks, slop hoppers, individual <sup>laundry</sup> tubs ~~for laundry~~ and shower baths. The Bath Tubs should always stand free so that they are accessible from all sides. Such tubs can be of porcelain or enameled iron, one being as good as the other, although the porcelain are considerably more expensive. In either case they should have solid bases extending below the finished floor. Each tub should be fitted with a bell supply fixture and a standing waste, thus leaving the entire inside of the tub free and giving access to all working parts for removal and cleaning. All fittings for these tubs shall be made of nickel plated heavy brass tubing and brass castings, or of white metal tubing and castings. The Slop Sinks should be sufficiently large to conveniently admit a large pail and, owing to the rough usage



which they receive, should be made of enameled iron. Their water supply should consist of a combination faucet of heavy brass, with a long spout with a bucket hook, and the entire fixture firmly braced by a wall support. Each sink should have a plug strainer, which will admit of its being filled. The Slop Hoppers for sanitary reasons should be made of vitreous ware. They should be so arranged as to have a long, strong, continuous flush and should be of the siphon jet type. Each hopper should be supplied with a long spouted faucet. They should be fastened to the floor in such a manner as to have a positive gas and water tight joint. The Laundry Tubs should have a back, should be made in one piece of enameled iron, and should set close to the wall. The Shower Baths should be of the simple type with a head spray and an overhead ring with a curtain, the whole apparatus being placed over the tub. Each shower should be equipped with automatic controlling valves and a mixing chamber, in order to prevent scalding and to obtain a uniform water temperature. The doctor's dressing room and toilet rooms are provided with a full shower apparatus. These Showers are placed in a stall whose sides are built of marble, slate or glass and the floor, which is countersunk and sloped to a central drain, of any of these materials or of tile or cement. It is necessary in all instances to put under this floor, of whatever material, except cement, a lead safing and the drain should be flush with the top surface and of sufficient size to carry off the water as quickly as it flows to it.

**Private Bath Rooms:-**

Each private bath room should be provided with a



lavatory, bath tub, shower bath, and water closet. All such fixtures should be of the same type and have the same equipment and installation as those in the general toilet and bath rooms.

Operating Department:-

The operating and dressing rooms should contain one or more good sized Sinks made of enameled iron and arranged for hot and cold water, filtered and distilled, each kind being supplied through a separate spout. They should be deep so as to conveniently contain the wash bowls and for sanitary reasons should be controlled by either pedal or knee action valves. The wastes should also be operated by pedal or knee action. The basins should be loose so that they can be <sup>removed and</sup> sterilized, and can be kept on hand in quantities. In the sterilizing room should be placed a Sink For Washing Instruments, constructed like an ordinary sink, but which has instrument trays at either end, which are an integral part of the sink. The faucets for this sink should be placed high enough so as not to interfere with work. The sterilizing room should also be supplied with one bowl and one instrument sterilizer. In the dressing room there is also a sterilizer for bandages and instruments. These Sterilizers are of the steam-jacketed ~~type~~ <sup>type</sup>, steam pressure. The operating department should also be fitted with an apparatus for generating formaldehyde gas for use with the permanganate of potash and formaldehyde process of disinfecting. There should be a drain in some part of the floor of the operating room and the whole room should be in such a shape that water will not hurt anything.

Obstetrical Department:-

Besides the regulation toilet and bath room equipment



the obstetrical department should be equipped with sinks and sterilizers such as are supplied for the operating department.

**Dressing Rooms:-**

All dressing rooms should be provided with sinks and sterilizers like those in the operating department.

**Laboratory:-**

The laboratory should contain a small testing sink, slop hopper and at least one large sink. This latter Sink should be made of enameled iron so as to be strong and acid resisting. It should be equipped with filtered hot and cold water, as well as the house supply of hot and cold water. There should be a long wooden drain board on each side and the whole thing should be installed in the working table in such a position that it will be handy, and this table should be so arranged as to be accessible from both sides. The small Testing Sink is used for experimental and testing purposes and should be supplied with distilled water. The laboratory should also be equipped with gas pipes for Bunsen burners which should run exposed at the rear edge of the work benches. Besides these there should be several swing fixtures arranged for blow-pipe work and provision should be made for supplying sufficient burners for special apparatus.

**Hydro-Therapeutics Department:-**

If there is a department for hydro-therapeutics it should be equipped with control tables, needle and shower baths, bidets, bath tubs, seat baths, shampoo tables, weighing scales, and bath stools. The Controlling Table is arranged with mixing chambers, each with a temperature-regulating valve, pressure-regulating valve, thermometer gauge and electrical alarm for indi-



cating high temperatures, and two special nozzles with different sized tips for pressure streams. Compression valves are put on to supply hot, cold and ice water to the table, and also to control the water to the various fixtures. The water pressure to these tables must be constant, as also the temperature of the water. The electrical alarm is attached to each mixing chamber and consists of a special thermometer with a battery and a bell, so arranged that when the temperature of the water rises to a point near scalding, the bell rings automatically, thus giving warning to the operator. The Needle and Shower Baths are arranged with four uprights, upon each of which is placed a number of rose sprays, the upper one adjustable, and also a large head spray on a ball and socket joint, so that it can be moved in all directions. The Bidet is a small nozzle, swing jointed, which is usually attached to the shower or to a water closet arranged for it. The Bath Tubs should be the same in equipment and installation as those in the bath rooms. The Seat Baths should be made of enameled iron or porcelain and should extend below the finished floor like the bath tubs. They should be wasted the same as the bath tubs. The Shampoo Tables should be made of enameled iron, marble, ~~or~~ glass or porcelain, mounted on enameled wrought iron standards <sup>or</sup> frames. Over these tables are placed shampoo sprays, which, if not controlled from the controlling table, should be equipped with a non-scalding device or valve. The Bath Stools are made of wood covered with celluloid enamel, with an opening in the center to be used in connection with the perineal douche.

#### Drinking Fountains:-

Drinking fountains are usually placed conveniently



in the corridor on each floor. Supplies for drinking water should also be placed in the main kitchen and diet kitchens. The fountains can be of the wall or pedestal type. The wall type can be recessed or attached directly to the wall. These fountains should be equipped with a cold water faucet from the refrigerator supply and a waste and S trap. The faucet should always be of the self-closing type and the supply should have a return pipe so that the circulation is complete, ~~and so that the circulation is complete,~~ and so that cold water may be drawn immediately without the necessity of wasting the water which has been standing in the pipe. Each fountain should be connected to this return, as should all other fixtures at which the supply of drinking water is drawn.

#### Dumb Waiters:-

The best type of dumb waiters are of the electric full automatic control type, so arranged that a push button on each floor brings the dumb waiter to that floor. The shafting should be of steel and all bearings should be fitted with anti-friction steel bearings, of the pin or ball type, to insure easy running. The cars should be of ample capacity to supply the rooms which they serve and equipped with strong shelves. Dumb waiters should be placed outside of the ward units because of noise they might cause and the tendency of their shafts to be fire traps. Because of this danger of fire these shafts should be made the same as those for elevators and stairs.

#### Vacuum Cleaning System:-

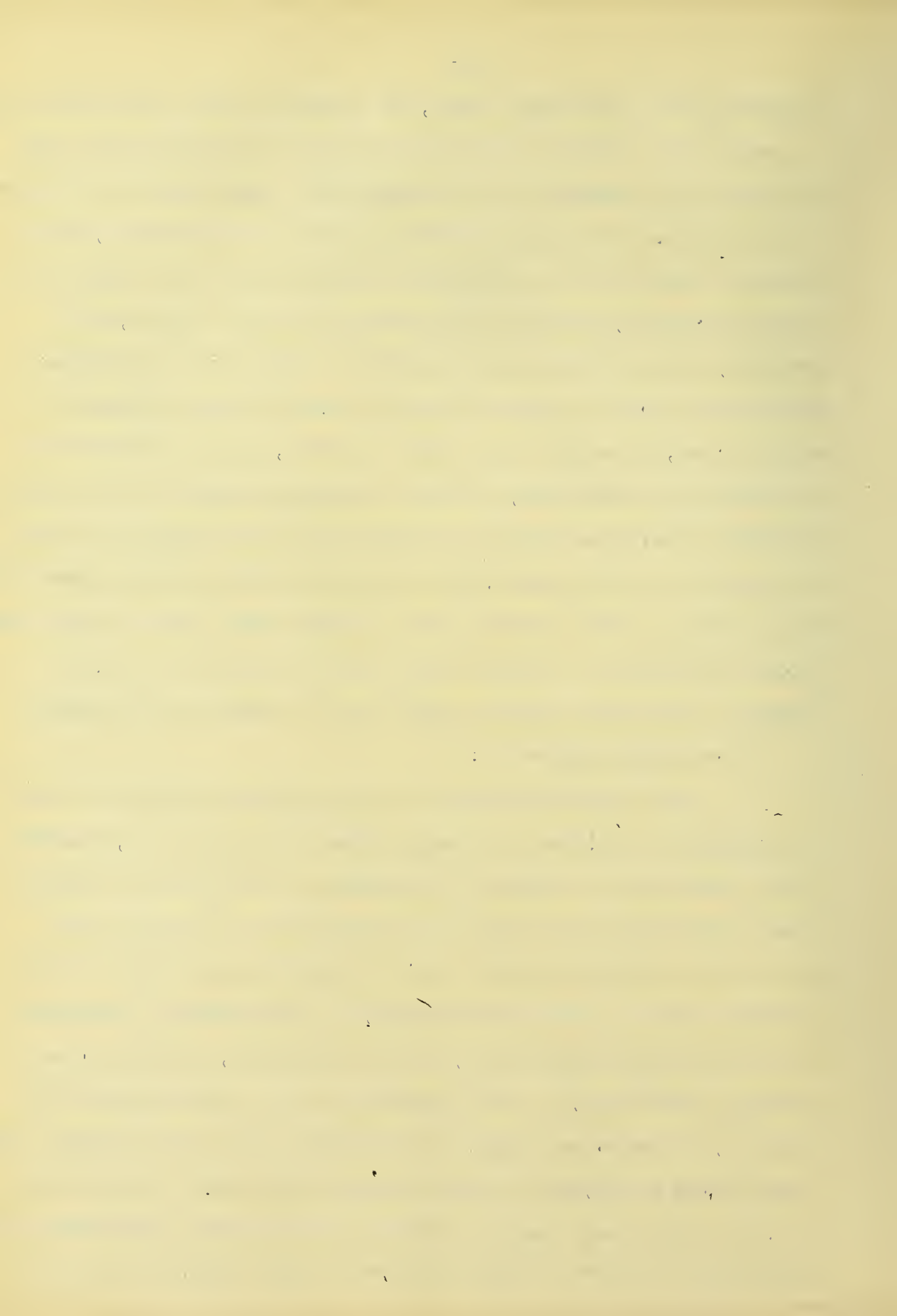
The hospital should be equipped with a vacuum cleaning system consisting of a vacuum pump or aspirator,



atomizing and condensing tanks, and piping to carry the dust and to which the cleaning tools and brushes are attached. The pump and tanks are located in the basement. The pump should be directly connected and can be driven by steam or electricity; if by steam it should have an automatic control. The tools consist of carpet sweepers, sweepers for hardwood and tile floors, wall brushes, clothes brushes, and upholstery brushes. The scrubbing brushes are made to permit water to run into them through a supply hose, the water being under control, and as the floor is scrubbed, the vacuum mop, as it is designated, takes up the water. Corridor floors and floors of operating rooms especially could be cleaned in this manner. The advantage of the vacuum system is the absence of dirt and dust and the ease with which corners and angles difficult of access with a cloth or broom and places somewhat above the ordinary reach can be reached and cleaned.

#### Sterilizing Apparatus:-

The modern hospital is not complete without its sterilizing apparatus. There are many forms of sterilizers, from the large apparatus for surgical dressings to the smaller instrument sterilizers. The steam for sterilizers is deprived from the boiler supply and this steam is used in the central disinfecting plant to disinfect bedding; for sterilizing instruments in the operating department; in the dispensary; dressing rooms; autopsy department; for the apparatus of the pathological laboratory; in the water baths; in the kitchen and diet kitchens for sterilizing foods; and for sterilizing water under steam pressure. The sterilizers used to obtain sterile water should have in connection a filter of the germ-proof stone form. The coils of



this water sterilizer should be removable and the whole apparatus so constructed that it is not necessary to use wrenches to remove the covers. Steam sterilizers for Pasteurizing or sterilizing milk in large or small quantities should be provided. Such apparatus is necessary in all hospitals, but especially in childrens hospitals and those having an obstetrical department. Steam sterilizers are used also in disinfecting ovens. These are of two forms, the rectangular and the cylindrical. They are used for sterilizing mattresses, bedding and clothing. The steam used by them must be superheated, dry steam, put into the ovens at high pressure, and the ovens must not be opened until they have cooled thoroughly, as opening before this takes place causes condensation and a consequent dampness of the contents of the sterilizer.

#### Garbage Crematories and Water Heaters:-

The object of the garbage crematory is to supply a cheap and effective method of disposing of refuse. Where there is a large amount of such refuse the consumption of coal for the raising of water to the required temperature for use in the hospital is small. None of these crematories, however, will operate on refuse consumption alone, and it is necessary to supplement this by coal. In large plants the water from these crematories is used as feed water for the boiler. The disposal of refuse ~~matter~~ from the wards in this manner prevents to a great degree the spread of contagion. In the types ordinary to hospitals, crematories are built with two chambers, the upper being divided from the lower by garbage grates. They are built in



several ways, either of steel with an inner and outer shell, or brick, set in the same manner as are furnaces for boilers. In the ordinary type the garbage and refuse is placed upon the bars, and the heat from the fire in the lower chamber dries this until it is converted into fuel.

#### Signal Systems:-

Systems for signalling from rooms and wards should be installed and the best type, because of its quietness, simplicity, and accurateness, is the electric signal system. This system is both direct and positive, as only the current of electricity which is used for lighting purposes is necessary. The apparatus consists of a pendant push button at the head of each bed connected with a red light, so as to be easily seen in the day time and not disturb the patients at night, at the door jamb or over the door and with a pilot light in the nurses' room and dirt kitchen. These lights remain burning until turned off by the nurse.

#### Telephone System:-

The hospital should be equipped with intercommunicating telephones. The best system is a private one which can be made to connect to the public telephone. In this way the disagreeable restrictions of the public system can be avoided. Each station of the system should be so equipped as to enable connection to be made from any station to any other station without the possibility of interference from another instrument, and which will permit two or more stations to operate at one time without interference with each other. The instruments should be



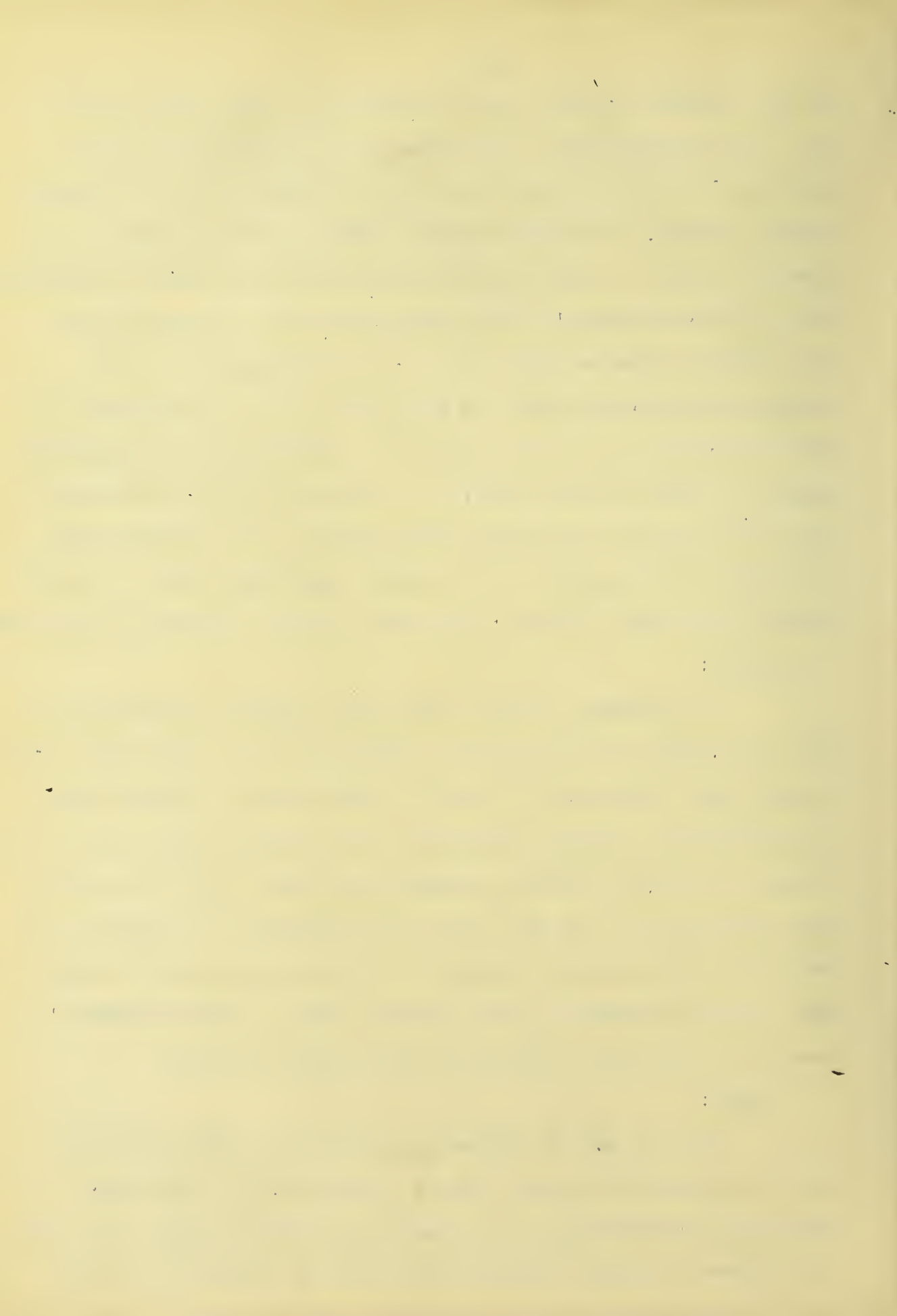
of the automatic switch and plug type. For twenty stations or less intercommunicating telephones of the individual push or individual switch or plug type should be used, but if more than twenty stations are used a central switchboard in charge of an operator should be installed. Telephone systems should be equipped with a superintendent's call button, which is a button on the main office telephone, that rings all the telephones on the system simultaneously. This is put on so that the physicians or other attendants can be called to the telephone by a designated number of rings on the floor, or at any part of the building, at which they may be at any time. The subject of the transmission of orders in a hospital is of so much importance that it is imperative that only the best and most accurate system be installed.

#### Bells:-

The number of bells and their location depend wholly upon the wishes of the hospital authorities, but they should have a sharp, full ring and be of such a size that the ringing does not disturb the patients. Under any circumstances there should be a push at the main entrance, connecting with a bell in the nearest room which is used day and night. Another bell connected to the front door push, and ringing at the same time as the main bell, should be placed in the matron's room or superintendent's room, or in both, with a small cut-out switch on each.

#### Power:-

Each piece of equipment, elevator or pump should be run by an individual motor, direct connected. This individual drive has the advantages of economy, quietness, freedom from dirt, and absence of danger. Installations must be figured for each



particular case, as no standard can be given, but should have a good percentage of excess power so as to be quiet and positive in operation.

#### Electric Plugs:-

Plugs for the attachment of portable electric lights or for connecting apparatus should be generously distributed. They should be uniform so that any lights or apparatus may be used in any room. Besides the plugs in the wards for lights, warming bags and electric fans, plugs either of the flush type or of the type to receive sockets should *be* provided for X-ray apparatus at fixed points, as also in the X-ray room. In the latter, however, special panel boards are usually installed. In the operating department there should be plugs *for* such apparatus as is electrically operated, such as galvano-cautery and apparatus for exploratory work. In the kitchen and diet kitchens there should also be plug receptacles with as many circuits for each as will be found necessary for any cooking or heating apparatus, although at the present time cooking by electricity is somewhat more expensive than any other form. Its cleanliness, rapidity, and ease of handling, however, as well as absence of odor, are so evident that it no doubt will eventually, to some extent, replace other forms of heat for cooking purposes in hospitals.

#### Lockers:-

The only locker worthy of consideration in any hospital is an all-metal one. The closed type form of metal locker, known as the "knock-down" type, is probably one of the best on



the market to-day, inasmuch as it can be taken apart in a few minutes, thoroughly cleaned or *renovated*, and put together in the same space of time. These lockers are made with the enamel burned on, which, with ordinary care, should last for many years. It is imperative that there be sunlight and ventilation in all locker rooms.

#### Blanket Drying Closets:-

In all hospitals there should be provided on each floor upon which there are patients, a space or room in which blankets can be quickly and readily dried. Such space need only be large enough to admit a drying rack on which the blankets can be *hung*. The simplest form of such a drying rack could be made by placing horizontally in a closet wooden poles over which the blankets can be hung, and into which closet are introduced steam coils or some form of heating. A sliding rack could also be run on tracks into a narrow room, or in part of a room for this purpose. A small drying cabinet, such as is provided in the laundry drying room, would be admirable in the latter case, as this could be heated by steam or gas. A space could be provided also for this purpose by building a slot about three feet wide, and a sliding rack either on tracks or on an overhead track, and when the blankets were on the racks or when the dryer was not in use could present on the exposed side a panel which would be flush with the wall of the room in which the rack was placed. All spaces for drying blankets must be thoroughly ventilated, and should under all circumstances be accessible for cleaning purposes.



**Stand Pipes:-**

Stand pipes with attached hose should be provided for for protection in case of fire.

**Hardware:-**

The hardware should be of the very best and of the simplest kind, so as to be easily cleaned and operated, and capable of withstanding the constant cleaning which is required in all parts of such a building.

**Furniture:-**

Furniture should be of the simplest form, free from carving and should be non-absorbent. Window hangings should not be permitted as they are unsanitary.

**Rooms and Departments:-**

We will now take up briefly the location and important details of the principal rooms and departments.

**General Wards:-**

The general wards should not contain more than eight beds as with small wards patients can be placed together so that they are congenial and it is possible to place those who are very ill or very recently operated upon in the same ward, which will prevent annoyance to others less ill. Moreover, the additional attention that must be given to these patients will not cause others less ill to become jealous because they do not receive the special attention given those who are needful thereof.

Each nurse will take an especial pride in her ward and there will be developed a wholesome rivalry between the nurses that will result beneficially for the patients. Small wards are



especially valuable in hospitals connected with medical schools, because one or more of the wards can be regularly assigned to a senior and a junior student for a definite period of time and in this manner secure for the student an opportunity to observe a definite number of patients from the time they enter the ward until they are discharged.

All wards should be so located as to receive the maximum amount of sun and air and in the U shaped plan this location is in the parallel wings. Rectangular wards are the most economical. Wards should be lighted from the sides, the beds being placed between the windows, perpendicular to the wall and two or two and a half feet from it. The beds should be placed about six and a half feet on centers. The center aisle should be at least eight feet and preferably ten feet wide. Fifteen feet is usually sufficient height. The basement under the first floor wards should be unoccupied, so as to keep these wards free from noise and odors. The sole object of the basement in this case being to raise the wards high above the ground.

In childrens' wards it has been found best to separate the sexes when the patients are more than ten years of age and some authorities insist upon the separation above the age of six.

In connection with general wards there should be a dressing room, diet kitchen, linen room, locker room, bath room, toilet room, medicine closet, nurses' room, soiled linen room, solarium, and a broom closet.

#### Private Wards:-

Private wards should be given the best location possible. In the U shaped plan this is on the court side of the



connecting link of the U.

In connection with private wards there should be service, linen, locker, and private bath and toilet rooms.

#### Recovery Wards:-

Recovery wards are placed in connection with the operating department and are of the greatest benefit to patients recently operated upon, as they are in charge of senior nurses and not removed to the general ward until they are in a condition not to disturb or be disturbed by <sup>the</sup> other patients.

#### Maternity Wards:-

Maternity wards, both general and private, are placed in connection with the delivery and baby rooms of the obstetrical department. This department should be given a good location, in the U shaped plan on the court side of the connecting link of the U.

#### Operating Department:-

The operating room should be located on the north side of the building because of the steady north light, which is the best for operations. The top floor is best for operations, because of the additional light secured from skylights, the freedom from street dust at this height, and the keeping of odors from the rest of the hospital. It is a good plan to isolate the operating department from the rest of the building by a connecting corridor.

The windows in operating rooms should be wide and extend up to the ceiling. It is not necessary that these windows come very near to the floor.



In connection with the operating room there should be an anaesthetic room,sterilizing room,nurses'room,surgeons' dressing room,bandage room,instrument room,X-ray room,waiting room,and recovery rooms.

#### Kitchen:-

The best location for the kitchen is on the top floor so as to prevent the odors from pervading the rest of the building.

In connection with the kitchen should be a scullery, kitchen pantry,bakery,special diet kitchen,cold storage room, store room,serving room,butlers pantry,dining room for the domestics,and a dining room for the staff and nurses.

#### Laundry:-

The laundry is also best located on the top floor because of its odors.It should have in connection a drying room, ironing room,soiled linen room,sewing room,and a linen store room.

#### Dispensary:-

In practically all city hospitals there is a public dispensary, where medicines are prepared and dispensed.It is a place where the poor can obtain medical advice and medicines gratuitously or at a nominal price.This should be in connection with the out patients department and should be under the direct supervision of the superintendent or house physician.

#### Out Patients Waiting Room:-

The out patients waiting room should be separated from the general reception room and is best placed in the rear so that the patients coming to this department will not come in



contact with the hospital patients proper. It should be connected with an examining room for out patients.

**Matron's and Superintendent's Suites:-**

The suites for the matron and superintendent should be near the main entrance and where their occupants can be easily called at any hour of the night. They should consist of a sitting room, a bed room, and a toilet and bath room.

**Receiving Room:-**

The receiving room, for the reception of patients, should be near the main entrance.

**Ambulance Entrance:-**

The ambulance entrance should be in the rear of the building and out of sight of the patients.

**Laboratory:-**

A laboratory for pathological analysis and research should be provided. It should be so located as to prevent odors from reaching other parts of the building. The best location is on the top floor.

**General Office:-**

The general office should be near the main entrance and should be in connection with the superintendent's office.

**Nurses' Bed Rooms:-**

The number of nurses to be provided for depends upon the character of the medical and surgical work in each hospital. If there are many cases of chronic diseases treated in the hospital, one nurse will probably suffice for every five patients. If the service is limited to acute cases, it will require at least one nurse for every three beds. In children's hospitals



where only acute cases are taken, it will require one nurse for every four beds; if chronic cases predominate, one nurse for six or eight beds will be sufficient.

#### Bed Rooms for Internes:-

Provision should be made for one interne for every thirty to forty beds.

#### General Toilet and Bath Rooms:-

The general toilet and bath rooms, especially the former, should be located and constructed so as to have a vestibule leading from them to the outer air. This helps to keep the odors from the wards and other parts of the building.

#### Morgue:-

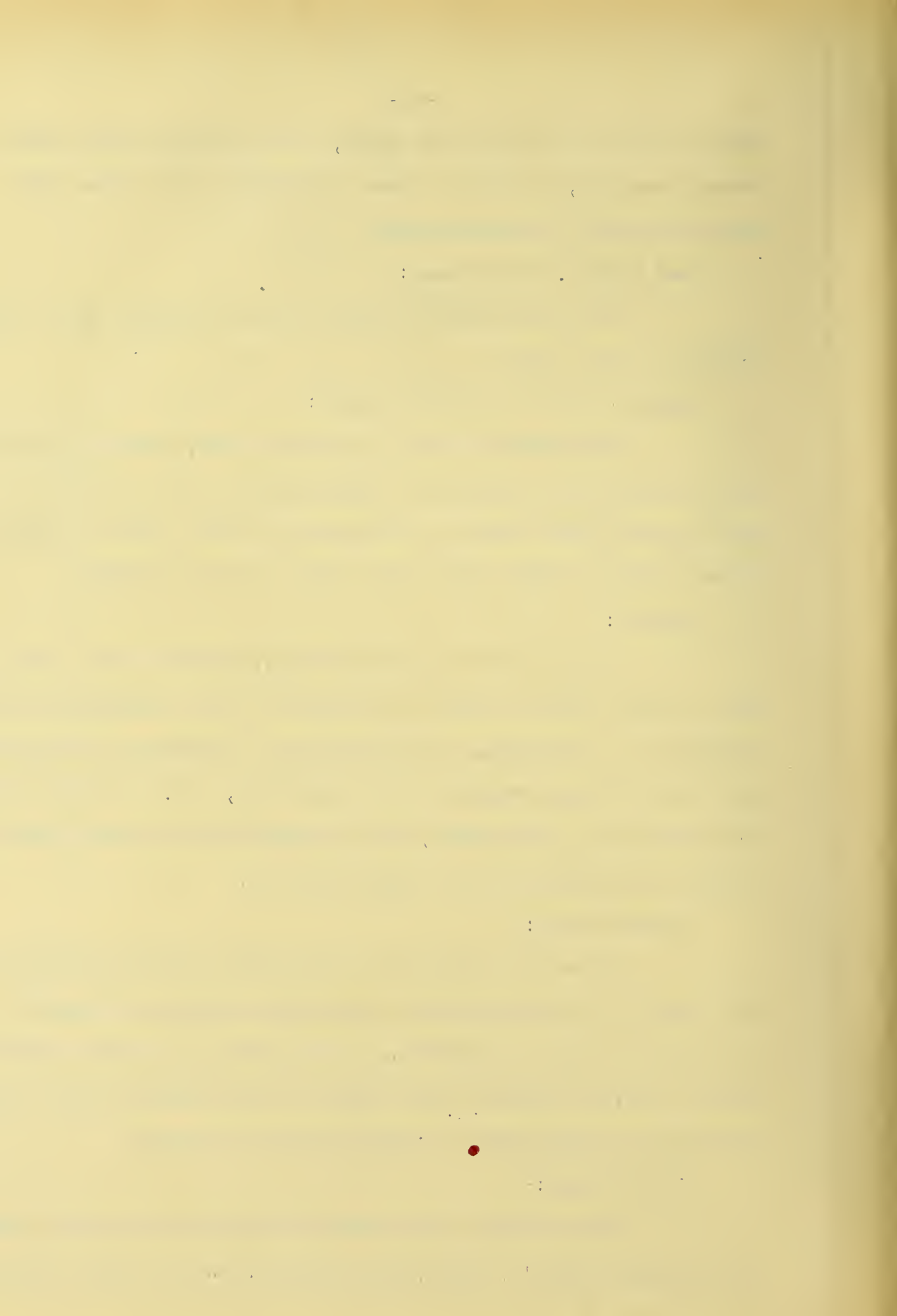
A morgue for the exhibition, identification and claiming of dead bodies should be provided in the basement. It should consist of a receiving and preparation room, where the bodies are received and prepared for exhibition; a cold storage room, for preserving the bodies; and an identification room, where the bodies are exhibited for identification.

#### Autopsy Room:-

An autopsy room, for post-mortem examinations, should be provided in the basement, in connection with the morgue. It should be provided with an operating table, sink, slop hopper, instrument sterilizer, and lavatory. The sink and slop hopper should be controlled by either pedal or knee action fittings.

#### Other Rooms:-

Besides the rooms mentioned there should be a nurses' parlor, head nurse's suite, house physicians suite, bed rooms for

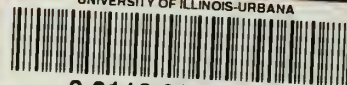


domestics, library, gymnasium, museum, janitor's room, boiler room, coal room, and an air chamber for the ventilating system.





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